TECHNICAL GUIDELINES
FOR
ELITE TRAIL ORIENTEERING

Timed control at the Ice House ponds, Day 2, WTOC 2012 Scotland

IOF Trail Orienteering Commission

2014

Summary

The key to high quality competition in elite international TrailO 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 for both PreO and TempO formats. They are also recommended as a basis for any TrailO event.

Trail orienteering continues to evolve and the IOF TrailO Commission may issue corrections and additions from time to time.

PREFACE

This is the five-year revision of the Guidelines. Since 2009 the discipline of TrailO has evolved considerably and, as you might expect with an activity that demands precision and detail, those two elements require more description and definition than ever before in the guidelines. These latest Guidelines are a third larger than those of five years ago.

It is the view by some in the discipline that this detail has gone too far and it would be better to simplify and reduce the Guidelines to a much slimmer document. Their argument is that more written detail leads to more opportunity for controversy about flag placement and more complaints. This is certainly the case if the planning has been less than rigorous. The opposite view is that less precise definition allows more interpretation and more opportunity to disagree with the planner. It also allows less careful planning. My impression is that a substantial majority of leading competitors and officials are of the opinion that increased precision in guidelines is necessary as the discipline advances. It may be that the next major revision will result in a different document but, for now, we believe this edition fairly reflects the requirements of the sport at the current stage of its development.

The Guidelines Revision Working Group hopes that this revision will be of service in supporting elite level trail orienteering for competitors and planners.

Brian Parker
Editor

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1. INTRODUCTION

Trail orienteering (TrailO) is one of the four disciplines of international orienteering. 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. Today TrailO is practised primarily by the able-bodied, all attracted to its technical challenge, but provision for mobility-impaired competitors is an essential element of every competition.

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.

There are two versions of trail orienteering. In the PreO (Precision orienteering) format the main course controls are untimed but supplemented by one or more timed controls in which the speed of decision-making is measured, the times being used as tie breakers. The newer TempO format consists only of timed controls. In TempO a time penalty is given for each wrong answer, which is added to the time taken on the timed controls. The total time including penalties then makes up the result list.

ESSENTIALS of ELITE TRAIL ORIENTEERING

In TrailO 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 (trails), usually tracks and paths, sometimes with wheelchair-friendly deviations 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. If this is so, then a letter code is recorded. If not so, with no flag matching the centre of the circle and the control description, a zero answer is recorded.

Since there are no codes on the flags, as in FootO, the flags are identified in sequence from left to right from a viewing point, marked in the terrain but not on the map, as Alpha (A) through to Echo (E) or Foxtrot (F).

An alternative form of problem in PreO competition is simply to identify whether or not there is a flag at the described and marked site; the answer is either A or Zero.

Currently the decision is recorded in PreO 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 may become standard.

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 compass.

Further introductory reading is *Technical Introduction to Trail Orienteering for Experienced Foot Orienteers (2010)* available on the trail orienteering document page on the IOF web site www.orienteering.org

ELITE TRAIL and FOOT ORIENTEERING COMPARED

There is widespread agreement, both within the trail orienteering discipline and elsewhere in the sport, with the IOF Council declaration 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;
- the greatly extended time for decision making at each trail orienteering control, which allows more information to be extracted from the more detailed and more accurate map, allowing more attention to be 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 of 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 and terrain reading can distinguish between flags that 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 at elite level of controls which are testing but fair, in that careful analysis of the map and terrain from the tracks leads to an answer that is significantly better than the other options, 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.

RELATIONSHIP WITH THE RULES

These guidelines supplement the IOF Competition Rules for Trail Orienteering Events.

Differences of interpretation between the guidelines and rules are not intended. Should such a difference occur, the rules shall take precedence.

2. TERRAIN REQUIREMENTS for ELITE TRAILO

There are stringent terrain requirements for trail orienteering.

Two questions have to be answered:

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

The best TrailO terrain, visible from the tracks and permitted areas, has complex ground and contour detail demanding skills of map interpretation. If rock, water and

vegetation features are also present, there may be opportunities for adding variety to the planning.

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

Trying to judge from an existing FootO map, at 1:15000 or 1:10000 scale, whether the terrain is suitable for elite TrailO, is difficult because TrailO mapping is typically at 1:5000 scale, requiring detail not shown on the FootO map, either because of generalisation smoothing the detail or there is no suitable fine detail present.

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 and that they can be represented on a map of suitable accuracy.

If the terrain has suitable TrailO features, it is then necessary to assess the quality of the existing map in its representation of them, in order to formulate mapping proposals.

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

This requirement is often the most difficult to meet at elite level, which requires a high technical level of terrain, often only accessible by tracks less wide and/or less smooth surfaced than ideal.

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 on narrower tracks 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 TrailO 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.

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

3. MAPPING for ELITE TRAILO

Maps for international trail orienteering are based on foot orienteering mapping specifications. They can be newly surveyed and drawn but also can be modified versions of existing foot orienteering maps.

Trail orienteering maps are preferably prepared in the ISSOM format, but ISOM is also acceptable with an additional resize of the symbols.

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

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.

The following technical guideline ***(TG)*** applies:

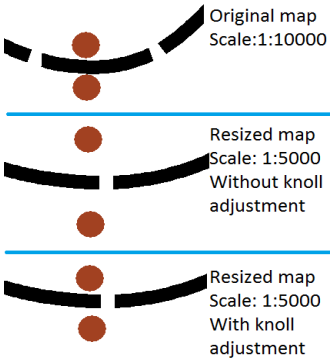
Map specifications recommended for international trail orienteering:

- ***1:5000 or 1:4000 scale with printed symbol dimensions the same as for 1:10,000 scale maps (i.e. at 150% of conventional 1:15000 foot orienteering map symbols in the ISOM specification). (TG 1)***

These specifications closely match those in ISSOM for sprint foot orienteering, this format being the preferred option.

Tip: Mappers modifying an existing FootO map for TrailO purposes may need to reassure themselves that the final symbol dimensions are as in the above guideline. It is not unknown for maps to have some or all of their symbol sizes non-standard.
A good starting point is to check the diameter of a dot knoll. Currently this is 0.75 mm.

In re-scaling from 1:10,000 to 1:5000 (or 1:4000) care needs to be taken with symbols drawn close together on the 10,000 map. It is possible that, for legibility, the distance between such features is greater on the map than in the terrain. The increased paper distance on the larger scale map allows displacements at the smaller scale to be corrected. The diagram illustrates this. The need for extra precision in fixing features on a TrailO map applies particularly for features used in sighting lines.



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 is not a specific intermediate contour and may be at any height between contours. Only one form line may be used between adjacent contours (ISOM 2000).

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 visible features on the map.

The concept of runnability cannot apply in trail orienteering but there is a close correlation between runnability and the nature of the vegetation affecting visibility in the terrain. 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)***

An advantage of using ISSOM symbols 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.**
However, with very short range features the out-of-scale width of the path symbol, a minimum of 3m on the ground, might give problems.

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

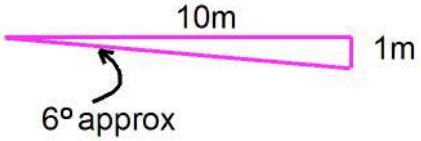
It is possible to survey and draw a new map especially for a TrailO competition and this is the natural inclination of most mappers. But this may not be best in terms of time, effort and cost. If the TrailO competition terrain is only a small fraction of the total mapped area, it may be more sensible to simply modify an existing map around the control sites. The existing map may have benefitted from the increased precision of laser contouring, in which case the contour adjustment and other changes to the map in the vicinity of the sites should be made without difficulty. If the existing map is older and less perfect in terms of contouring, there may be an understandable inclination by the mapper to 'start from scratch' with a new map. However, it might be possible to modify the map by reconciling the laser contouring with the existing contouring around the control sites. Although many, perhaps most, mappers may be uncomfortable with such a compromise, it is only they who are aware of the hybrid nature of such a map, the competitors concentrating on the control sites will only see perfection! The harsh economic reality of trail orienteering competition often demands the most cost-effective method of producing the required high quality map.

The compromises in using a FootO map for TrailO mapping are not just about contouring. Other features can be involved. The FootO mapper may be concerned when the requested changes conflict with the standard adopted across the whole 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 TrailO control sites. The solution is to persuade the mapper that this requirement is for a one-off special version of the map for this competition only, and the map file can be archived after the competition.

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 that 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.

Although precision compass bearings may be used in mapping and planning, such accuracy should not be demanded of competitors, for whom the standard orienteering compass is sufficient.

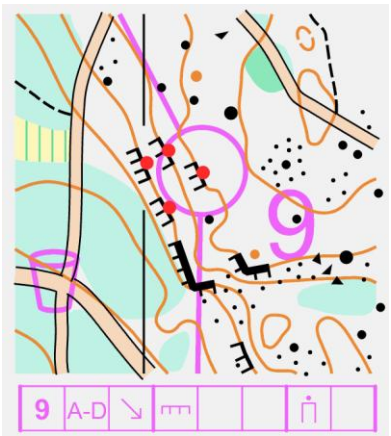
Maps in this document
The map segments in the following pages are for illustrative purposes and are modified extracts from competition maps and solution sheets. The latter show individual flag positions and a decision point. Most are at a scale of about 1:2500.

4. POSITION-FIXING TECHNIQUES

Trail orienteering is all about position-fixing: position-fixing on the map and position-fixing in the terrain. There are several position-fixing techniques in elite trail orienteering. Some of these are well-established classic orienteering techniques used in FootO and are labelled as such. The others are more recent developments in map reading and terrain interpretation particular to TrailO.

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.



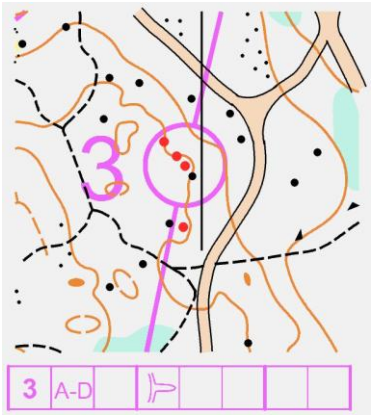
Example: A map reading exercise, simple on the map but complicated in the terrain by small unmapped features and visibility restricted by vegetation.

The red dots represent control flags.

The task for this kind of problem is to locate the correct feature, not to specify the exact location of the flag on the feature.

Position by contouring (Classic)

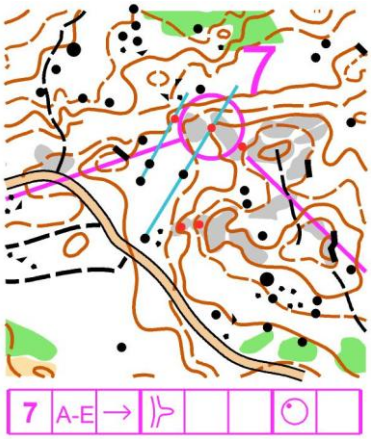
This is an advanced form of precision position-fixing which requires skill and practice. It is the tracing across the ground of a contour or form line from a selected reference point on the map. The reference point may be a feature at the same height as the contour or it may be between features at different 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 that 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 that 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 essential that all features which could reasonably be 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.

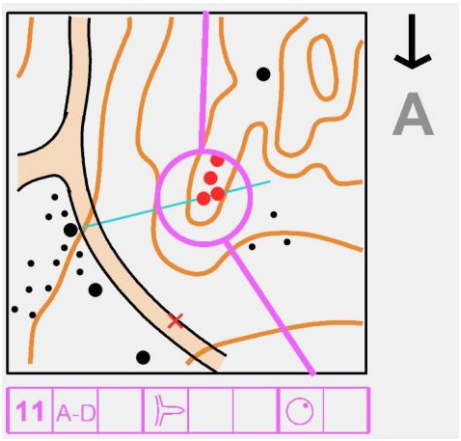
Wheelchair users concerned about the magnetic effect of their wheelchairs may prefer an eye-level sighting compass to take bearings.

For precision compass problems, the following guides should be met:

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

- ***When taking bearings of flags from a suitable sighting point, which can be accurately fixed on the map (not necessarily the same as the decision point), the control point flag/position and adjacent flags should not be less than 5^{o} apart in bearing. (TG 3a)***

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^{o} 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 'precision bearing' problem is designed to be solvable with a standard orienteering compass, it is good practice for the planner, when setting the flag positions, to use a more precise sighting compass to minimise aggregate competitor plus planner error.

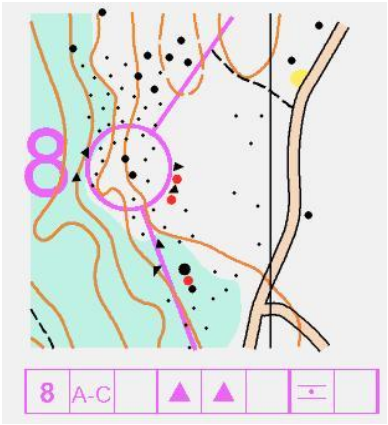
Position by distance estimation

1. Into the terrain (range)

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 guide should be observed:

- ***Distance in range into 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 symbol, boulder fields (ISSOM symbol 208) each contained a prominent boulder, which could be interpreted as the mapped pair with a flag between. The correct pair, unflagged, were 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. Across the terrain (bearing)

Estimation of small distances across the field of view in the terrain can sometimes be achieved by using the control makers as measuring aids. The control flags have 30cm squares and are usually suspended from a stake/pole/rod of 1m height. For IOF competition it is good practice for the planner to use the same height equipment throughout and announce that height to the competitors.

Estimation of larger distances across the field of view at a particular range can be assisted if there are features on the map at that range, which can be used as a calibration. If no such mapped features are available a possible alternative is 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 15%. (TG 5)

Measurement of distance along a track by pacing is normally from an identifiable feature on the map. A much more testing form is when there is no mapped reference point, as in the following example:

Example: This is a particularly difficult contour problem solved by distance estimation along the track. 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 from an arbitrary feature not on the map. This distance was then fitted to the hill to locate the form line and fix the flag positions.

Use of rough techniques for approximate position-fixing

The use of rough compass bearings may assist in the identification of 'which of several' features is relevant to the control problem.

There may also be usefulness in rough contouring. This is not exactly the same as contouring; there might be several contours that all together create a shaped feature that the competitor should be able to locate in the terrain.

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 of contour and feature recognition 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 7 *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.

Planners need to take care that they do not demand too high a precision from the competitors. Whilst planners and mappers can fix the centre of a circle to better than 0.1mm (by enlarging the map on the screen), competitors should not be required to judge better than 0.5mm on the map.

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)***

- **If more than one description can be used for the control, the one which offers the most precise position shall normally be preferred.** ***(TG 8)***

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.

The centres of the control circles should be placed on the map with the best accuracy available, typically to 0.1mm.

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 primarily of land form and rock, but also 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.

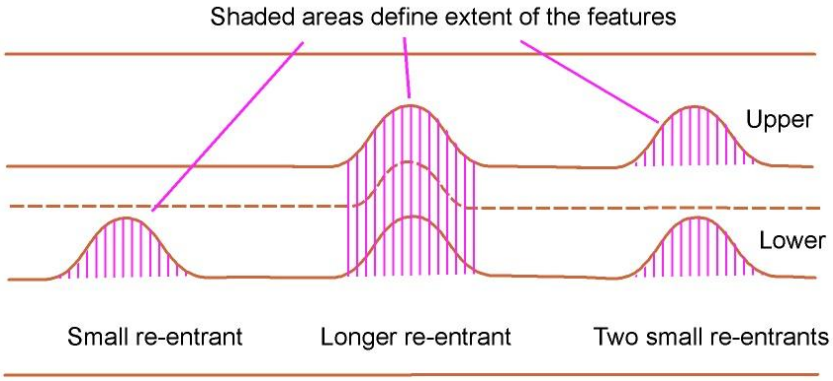
In principle, controls may be placed on, or in association with, any feature marked on the map, subject to certain constraints:

- **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 9)***

Adequate visibility refers to being able to sight the control from the decision point and any other necessary viewing points, in particular for users of 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 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 significantly increased. These concepts are shown in the diagrams:



Note that the two curved contours in the second diagram, if without a form line, <u>may</u> represent two separate features, upper and lower in Column C of the description, as in the third diagram.

An important difference between FootO and TrailO practices, which needs to be understood, concerns linear features. Linear features that do not have a bend or corner to define position can invite controversy, if used in FootO, but can be used in TrailO, if reference to other features allows precise location of a point on the linear feature. See example in later section: 'Examples of flag position and description'. 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 important difference between the two disciplines is that, when selecting from a group of similar features (say, boulders), TrailO planners are not restricted to the middle boulder or, for example, the northernmost boulder. If it is possible for others in

the group to be precisely located by reference to other features, the description 'boulder' is acceptable (See TG 11 below).

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 10)***

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

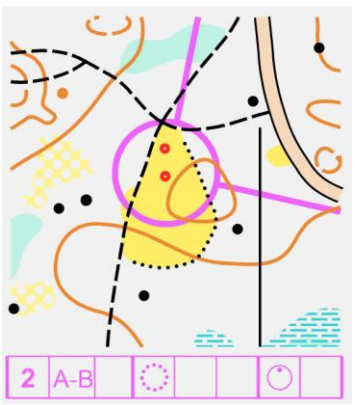
- **The control description may correctly apply to more than one flag.** ***(TG 11)***

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 TrailO competition.** ***(TG 12)***

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

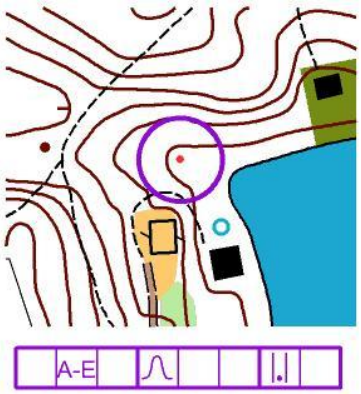
Description: '*Hill'*

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:

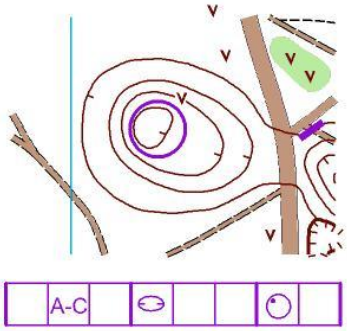
- **The description should take note of the visible extent of the feature in the terrain as well as its representation within the circle on the map.**
  (TG 13)

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 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'.

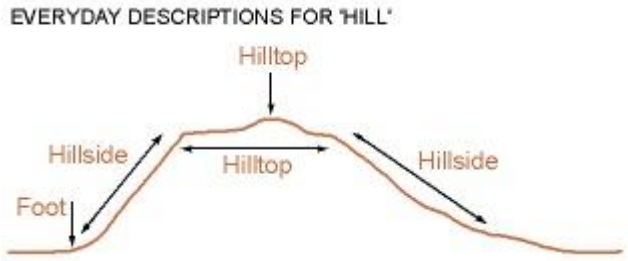
Similar convention applies to hills with several contour rings.

Examples such as these, in which the feature extends well outside the circle and modifies the description, need a common-sense approach by the planner and event advisor.

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, use 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.

- 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 best avoided for hills in elite orienteering.

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

DEFINITION OF DESCRIPTIONS USED IN COLUMN G

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

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

FOOT – Used for the edges of features that 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, where the top is at the mid-length of the feature.

BETWEEN – used for the mid-point of 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.

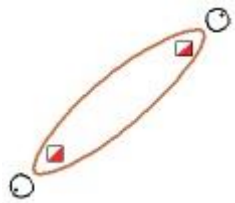
END – used to indicate the distinctive end of a linear feature. The orientation of the symbol, in one of the eight compass directions, indicates in plan view the orientation of the linear feature and its end.

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 - 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. The flag is placed either on the tip or immediately outside the tip, as the symbol indicates.

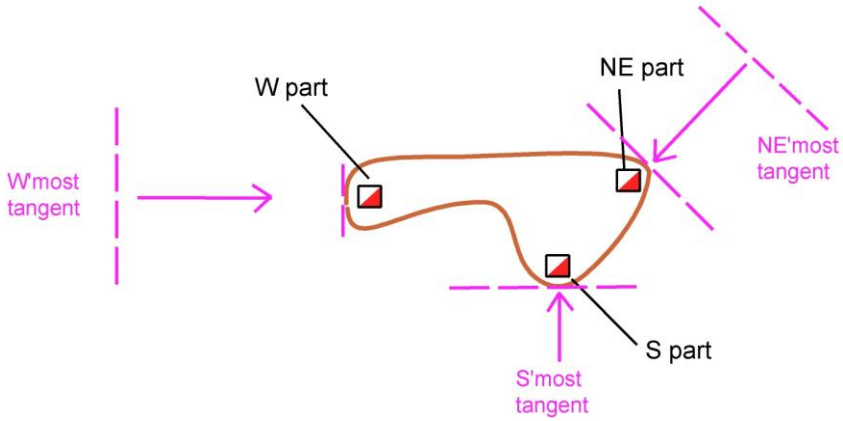
BEARING – there are 8 permissible positions based on compass bearing: N, NE, E, SE, S, SW, W, NW.



With some features, such as the elongated hill 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.

With more irregularly shaped features the direction may be identified by the **'tangent'** or **'approaching front'** method. 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.



This awkwardly shaped hill shows the tangent method in use, giving three good direction descriptions for **part**. The other five directions, in this example, are less satisfactory and best not used.

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

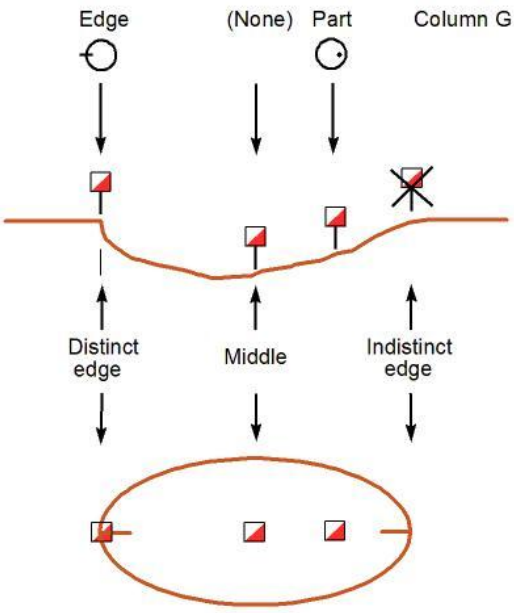
In the diagrams the sections are W to E, looking N. The plan views are conventional, with N at the top of the page. The flags indicate permitted control positions – for a zero control the flag would be absent.

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.

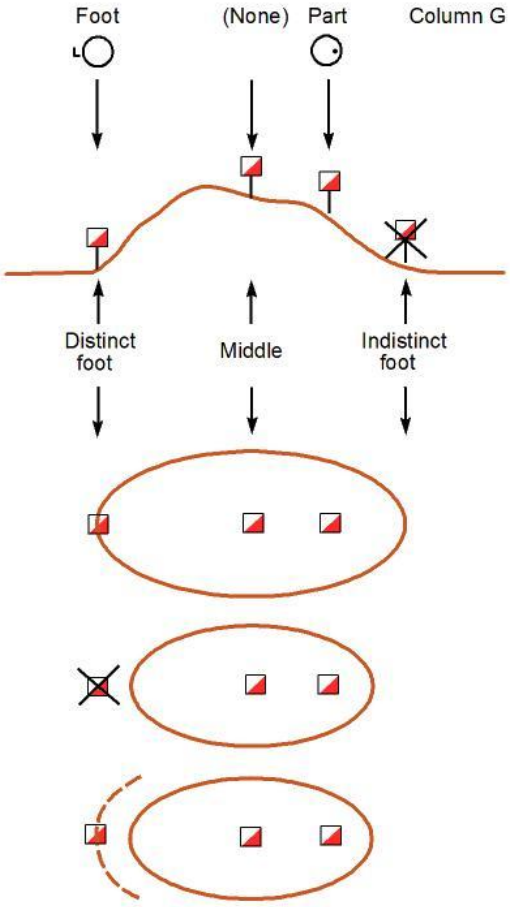
Hill

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.

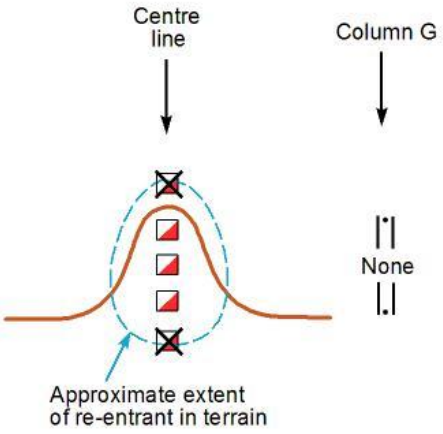
If the contour marks a distinct foot, the control point may be placed there and described as **foot,** with direction indication.

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, <u>unless a form line is added.</u> The description is then either 'Hill, foot' or 'Spur, foot, depending on how the form line is drawn.



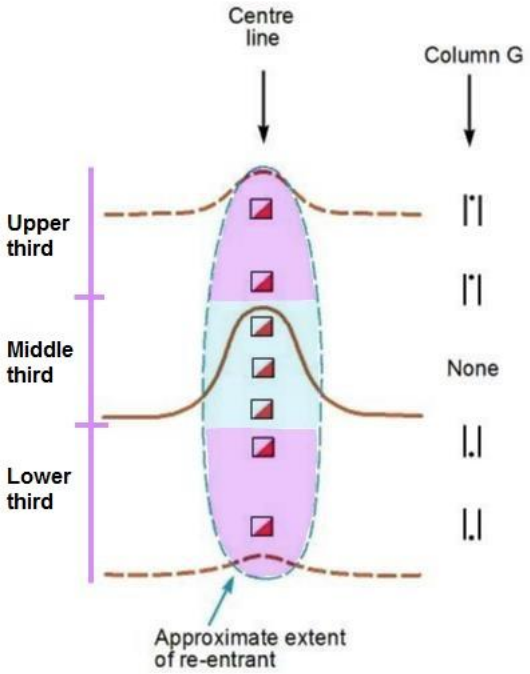
Re-entrant

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 this case the *midpoint* along the *centre line* passing through the re-entrant is described as 'Re-entrant'. Control positions along the centre line above this point (upper half) are described as 'Re-entrant, upper part' and positions along the centre line below this point (lower half) are described as '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.



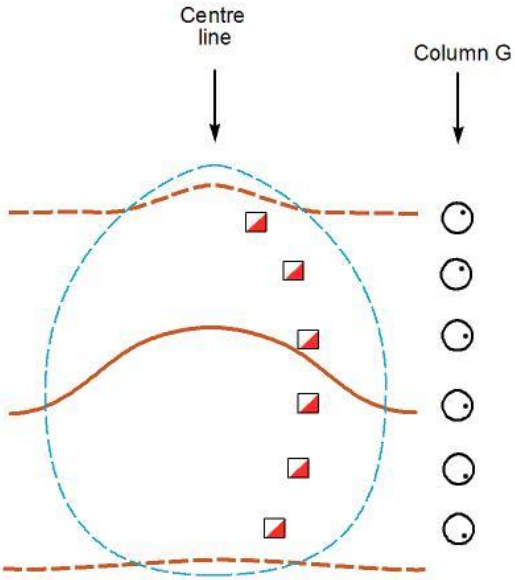
In such cases it is necessary for the extent of the re-entrant to be more fully shown on the map with more than one contour line or form lines. This allows its defined area to be greatly increased and most of its extent may be used for control positions and described appropriately.

As shown in the second diagram the centre line passing through the complete feature in the terrain is split into three parts. The centre of the circle may be placed within the upper third and described as 're-entrant, upper part', within the middle part and described by 're-entrant' and within the lower part and described by 're-entrant, lower part'. The correct flag must still be placed in the centre of the circle. This 'rule of thirds' applies only to features extending over several contour/form lines.

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, as indicated, 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.



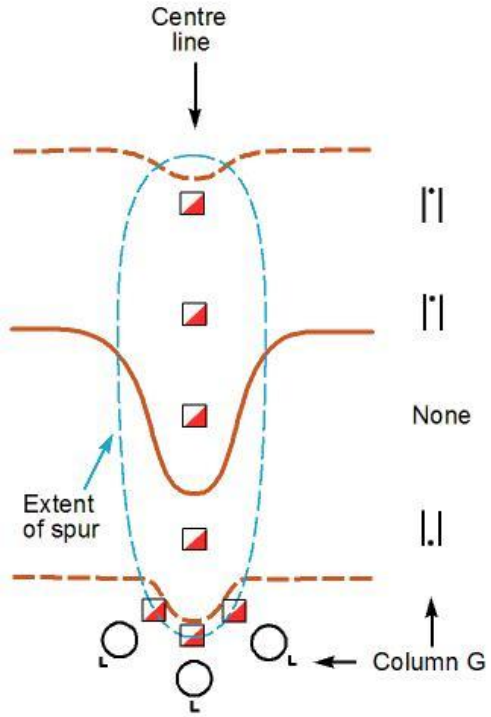
A **wide re-entrant** is an area feature and controls may be positioned off the centre line and given a direction description. The diagram shows control positions in the NE, E and SE parts of the re-entrant. Other positions in the NW, W and SW parts are also possible (and along the centre line).

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.

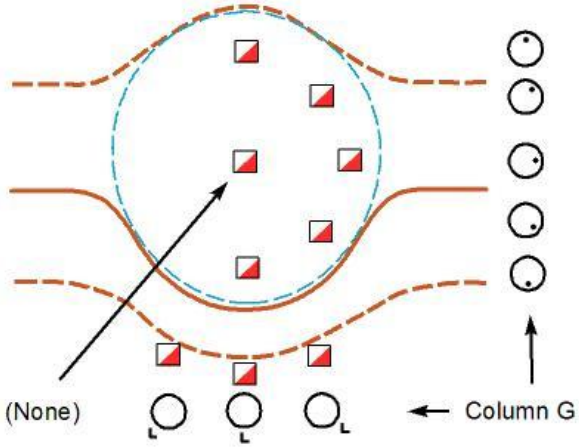
For wide spurs the same principles apply as for wide re-entrants and controls may be positioned off the centre line and given a direction description.

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 can be regarded as a flat-topped wide spur. The whole extent of the flat top, termed *terrace*, may be used for control positions, provided the upper form line is on the map. The lower form line shows the foot of the feature and this is referred to as *spur foot*.

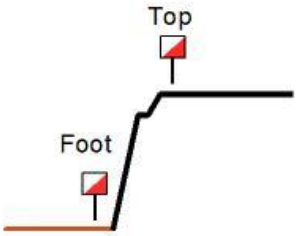


The diagram shows control flag positions in the N, NE, E, SE and S parts of the terrace. Other flag positions are possible. These have direction descriptions. The centre flag has no description.

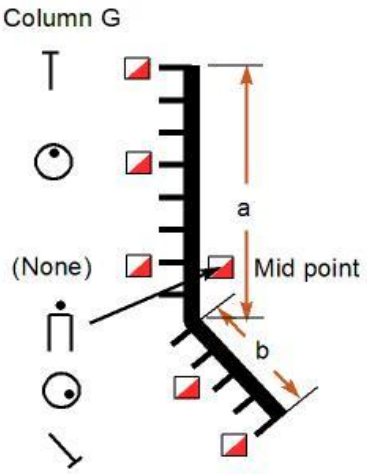
The control flags at the foot of the spur are positioned at the foot in the terrain. This is separate from the contour line in this example which marks the edge of the flat area further up the slope. If used for a control, the foot must be marked with a form line.

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.



Tip: Flags which have to be positioned a short distance from the rock face, or any other feature, may have their stakes tilted towards the feature.



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’. Also, ‘end’ may be used, provided the map shows the whole length of the rock face.

A flag may be positioned at the rock face **top** at mid-length and described by the 'top' symbol; it is not necessarily at the highest point. .

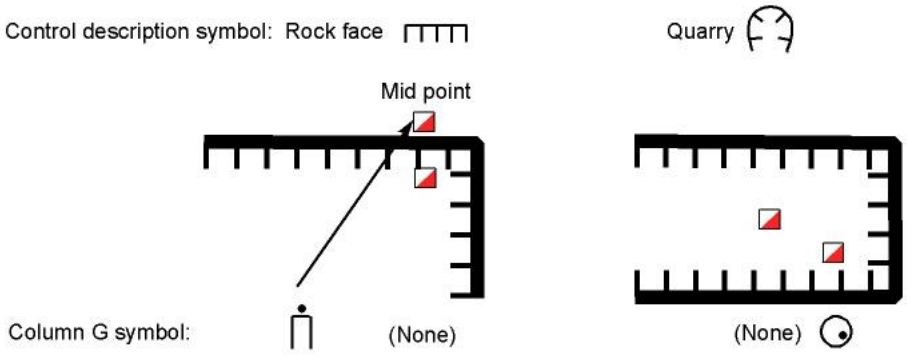
Note that, under current rules, no other flags are permitted along the top of the rock face, because double descriptions would be needed to identify them.

Quarry

A rock face, conventionally mapped, is a linear feature. A rock face that is not straight but has convex form, such as that in the previous diagram, remains a linear feature. However, if the form is concave and sufficiently extended, it can become an area feature.

This is shown in the two diagrams. That on the left is still a linear rock face and offers flag placements similar to the previous example. The diagram on the right shows the rock face enclosing an area, now termed quarry.

Flag positions additional to those marked are possible.

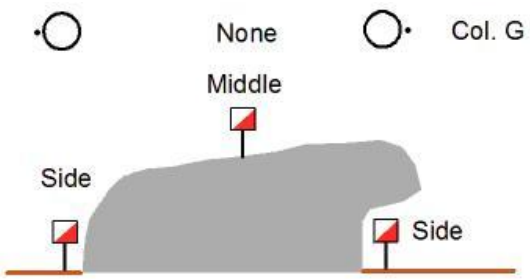


Earthbanks

Also known as steep slopes, earthbanks which have a well defined foot and top, together with well defined ends can be treated the same as rock face and quarry above.

Boulder

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

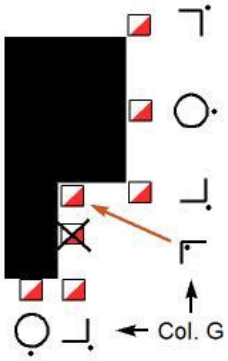


Flags are normally placed around a boulder but may be positioned on the boulder. A flag placed on a boulder in the middle

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

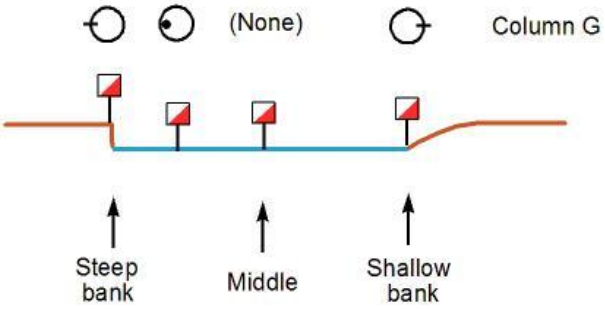


Control flags may be placed round the foot of a building at the mid-length of a projecting side (i.e. that which is furthest in a given direction) or at outside and inside corners. The descriptions are 'side' and 'corner'.

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 (See also **Linear features**, later)

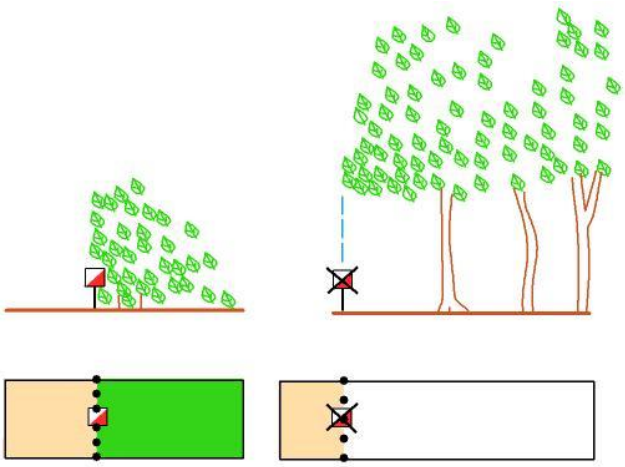
Vegetation boundary

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.

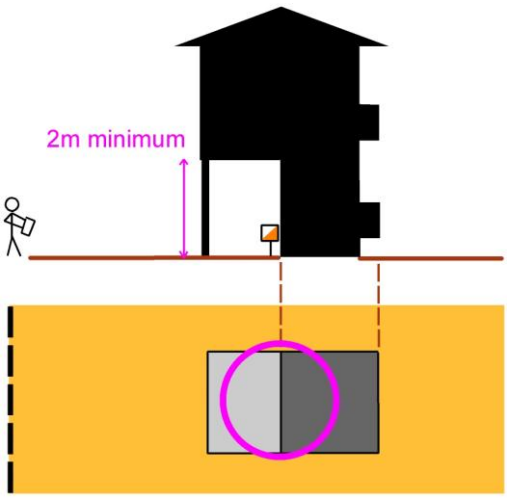
On the other hand, when the vegetation extends to the ground or almost to the ground, as in the first diagram, there is no difficulty.



Note that, for the terrain within the trees to be mapped runnable white, the clearance under the canopy should be 2m or more.

Overhangs

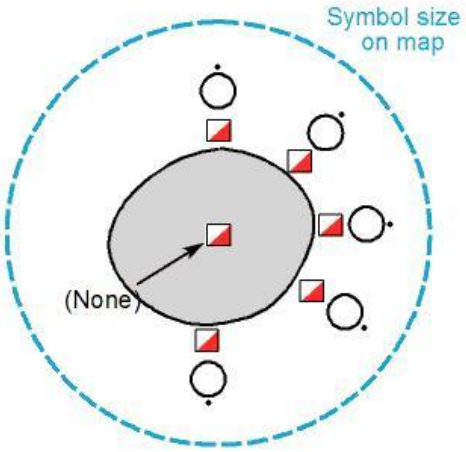
Similarly to runnable forest the clearance underneath building overhangs should be 2m or more in order to be mapped with the grey symbol. The mapped footprint should represent the main structure. Here the balconies have been included but should not feature in flag placement.



Roof projections, unless very large, should be ignored.

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 (ISSOM symbol 206) is equivalent to a diameter of 3 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:

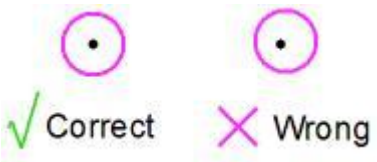
- Boulder - 'side'
- Knoll - 'foot'
- Pit - 'edge'

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 TrailO is that,

- **with point features, the circle is centred on the feature symbol and not offset in the direction of a flag on the side or edge of the feature.**

(TG 14)

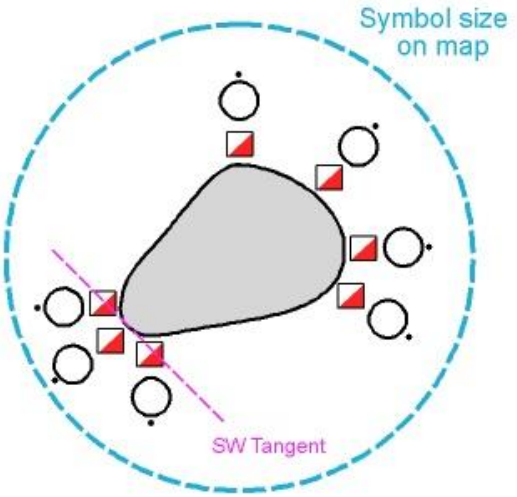
Here is an example with a Boulder NE side control:



Irregular point features

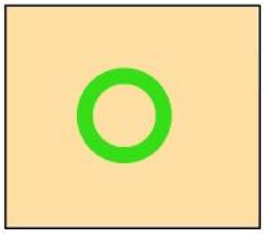
Irregularly shaped point features sometimes offer micro positioning of flags with different direction descriptions. If the shape of the feature allows adjacent directions to be clearly identified from one or more viewing positions, then the problem is acceptable, but caution should be exercised with such micro-precision.

Here is a permissible example of a suitably aligned boulder, with closely positioned but differently described flags on its SW side:



Individual trees

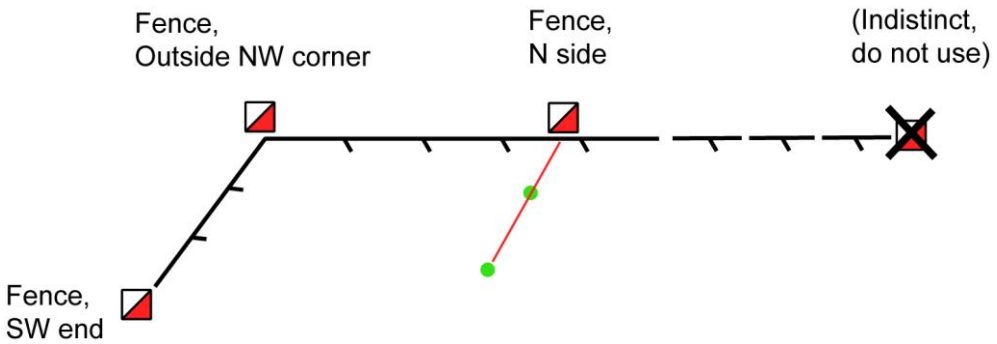
Distinctive trees, in open land or in the forest, may be mapped with a point symbol (usually green circle). In this case the symbol represents the trunk of the tree. The flag placements are the same as with the boulder example above. The flags are placed as close to the trunk of the tree as possible.



Single trees in open land and mapped only by the extent of their canopy are shown as area features and cannot be used unless re-mapped as point symbols.

Linear features

In foot orienteering linear features can only be used for flag placement if the feature has a clearly identifiable end or change of direction. In trail orienteering, position fixing from nearby features may allow other parts of the linear feature to be used.



Note that a fence corner is a precise position and self-defining but a fence bend is an extended linear feature, which may be compact enough to be used in FootO, but requires additional description in TrailO: e.g. ‘fence’, ‘bend’, ‘side’. Double Column G descriptions are currently not permitted. A possible solution is to omit the description ‘bend’, referring only to ‘fence’.

Linear not-to-scale features

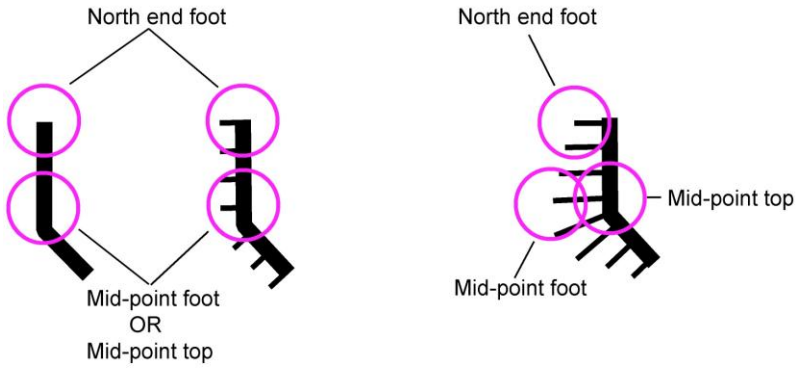
Straightforward examples are paths, streams, ditches, small erosion gullies, etc where the symbol on the map is wider than the feature in the terrain.

In all of these the control circle is positioned on the centre line of the symbol, and not displaced in the direction of the flag, if positioned to the side (e.g. path) or to the edge (e.g. stream).

More complicated are rock faces and earth banks, which require special attention.

A rock face may be represented on the map by a single black line or a black line with conventional tags to show the direction of the face. The conventional tags are ignored (even though they may equate to the actual extent of the rock face in plan view) and the control circle is centred on the black line.

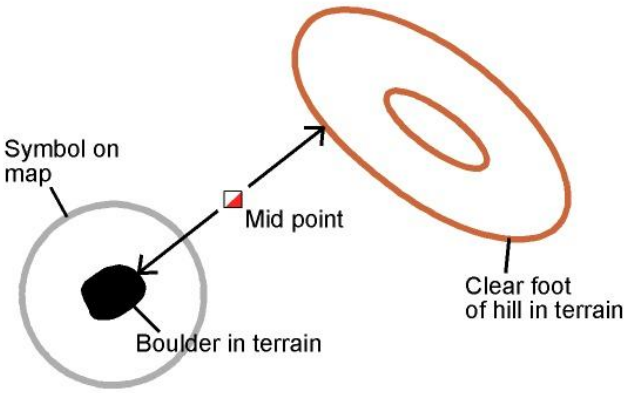
Sometimes a large rock face has considerable lateral extent and is represented by a thick base-line with extended tags. It is then considered an area feature and the control circles are placed in actual map position.



The same procedures apply to earthbank symbols with tags.

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 or foot of the features. If necessary, form lines must be added to define the edge/foot.

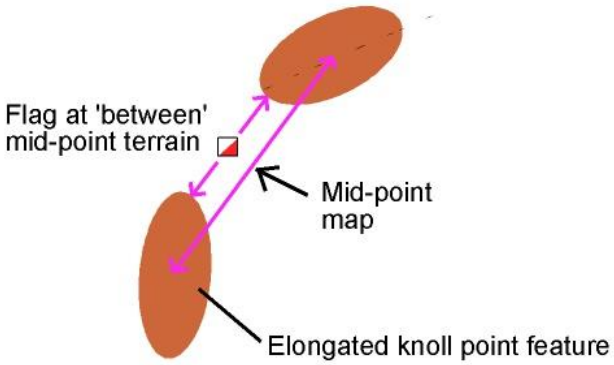
In the case of point features whose map symbols are larger than the objects they are depicting, such as boulders and knolls, the **actual** edges of the features **in the terrain** are used in defining the separating distance.

In the example, ‘Between the boulder and hill’, the diagram shows the correct position for the flag in the terrain.

Marking the position of the centre of the circle on the map depends on whether the features are to scale or not.

For mapped-to-scale features the control circle on the map is simply positioned at its correct location in the terrain. For two point features the circle is positioned at the mid-point between the centres of the mapped points (but see the variation below). For combinations of point and to scale features (as in the example) the circle is centred between the centre of the point feature and the edge of the mapped-to-scale feature.

Variation. It is possible, with angled point features such as the elongated knolls in the diagram, for the mid-point and the actual position of the flag in the terrain to be different. In such cases, practical sense should prevail and the circle should be centred on the flag position."



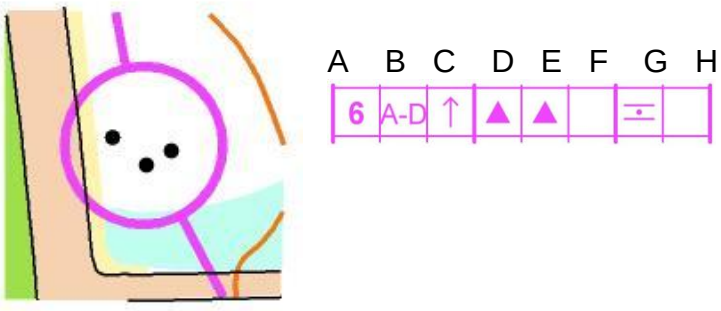
Use of other positions along the line requiring two Column G symbols (such as ‘Between, NE part’) is not recommended at this time. However, controls may be sited at the ends of the line and described in association with the adjacent feature (e.g. Boulder, NE side).

For good control setting it is necessary to set limits on the separation of between features and how they are described:

- **Only features within or partly within the circle shall be used for setting problems using the 'between' description.** ***(TG 15)***

- **The Column C direction description should identify which <u>two</u> features of several within the control circle form the 'between' pair.** ***(TG 16)***

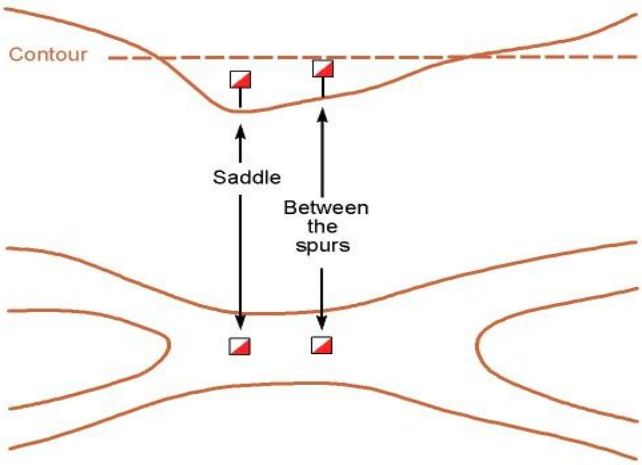
These recommendations are illustrated in this example of a multiple 'between' control from the model event at WTOC 2004.



Column C describes which **pair** of the features in Columns D and E **within the circle** defines the control. Having, in this case, identified the northern pair of boulders, the control is positioned, according to Column G, at the mid-point between them. This is very clear and complies with the *IOF International Specification for Control Descriptions 2004.*

Saddle

Care needs to be exercised with 'saddle' (also known as 'col'), which is the lowest point on a ridge between spurs. The lowest point is not necessarily midway between the contours.



A saddle control may not be of sufficient difficulty for elite competition (unless one of many in a complex area) as the lowest point can be easy to determine. Between the contours may offer a better problem.

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 variation 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 17)***

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

OVERLAPPING CONTROLS

It is permitted for flags visible from more than one control decision point to be part of the problems set at those decision points, unless excluded by tapes laid in the terrain.

THE 'A' CONTROL

It is now common practice in elite competition to have the single flag problem (answer A or Zero), identified in Column B of the description with just the single letter 'A'. Such controls have already been used in WTOCs.

The early use of the single 'A' control had only one flag visible from the viewing point. Current practice allows more than one flag to be visible.

Competitors are required to identify the circled and described feature in the terrain and decide whether there is a flag in the correct position or not, without being excessively distracted by other flags that might be visible from the viewing point.

Note that, with 'A' controls, it is not necessary to lay tapes in the terrain. Tapes are only needed with 'A-B, A-C, etc. controls in the presence of other visible flags, so that the flags for the control being analyzed can be identified in the sequence A, B, C, etc.

To maintain quality of course setting with 'A' controls it is necessary to limit the number of flags and the degree to which they can interfere with each other, the following procedures are recommended:

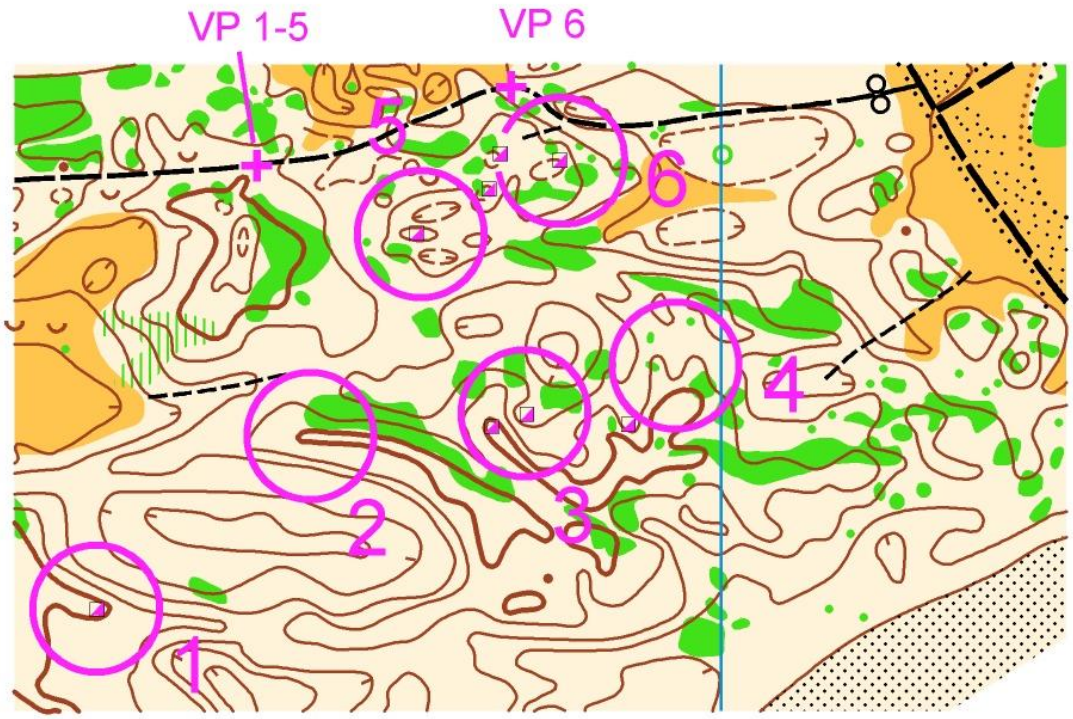
- **For each 'A' control there is only one flag, which is either correctly placed at the feature (A) or incorrectly placed at the feature (Z) or placed on a feature nearby (Z).** ***(TG 18)***

- **It is permissible for markers from other 'A' or multi-flag (eg. A-C) controls to be visible from the 'A' control viewing point.** ***(TG 19)***

- **For any 'A' control, flags other than the 'A' control flag may be positioned within the 'A' control circle, but must not be on features similar to the control feature.** ***(TG 20)***

A set of 'A' controls grouped together, viewed from one or more viewing points, is termed an **'A' Cluster**.

The principles of 'A' control setting are shown in the following example:



This example shows a cluster of 'A' controls (1-5) with an overlapping conventional control (6) nearby.

The area contains a total of 8 marker flags, one for each of the five 'A' controls and three for the conventional control.

All 5 'A' controls are viewed in this example from a common viewing point (but separate viewing points could be used.

#1. 'A' control. Spur, upper part – marker flag correct (A)

#2. 'A' control. Spur, upper part – no flag (Z). The flag is on the spur to the east.

#3. 'A' control. Re-entrant – flag correct (A). Note that the Control 2 flag is close but on a clearly different feature.

#4. 'A' control. Re-entrant – no flag (Z). The flag is in the next re-entrant to the SW.

#5. 'A' control. Hill – Flag correct (A). The flags for Control 6 to the NE can be seen from the cluster viewing point. They are on similar features but, since they are outside the Control 5 circle, they are not interfering. Had a Control 6 flag been placed on the east hill inside the Control 5 circle, it would interfere and not be acceptable.

#6. 'A-D' control. Hill, NE foot. Flag A is the answer. Note that the Control 5 flag is visible from the Control 6 viewing point and is then the 4th flag for that control. Alternatively, it could be taped off and the problem is then A-C.

LONG DISTANCE CONTROLS

Long distance controls with larger features make potential valid control sites provided the marker flags are clearly visible and will remain so during the course of the competition when light conditions may change.

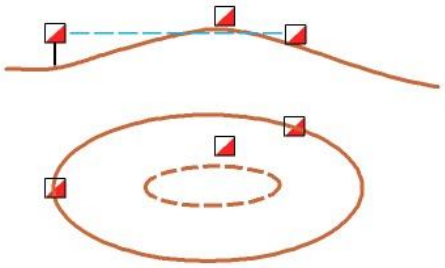
An acceptable solution is to increase the flag visibility by using two standard flags hung one above the other on the same stake.

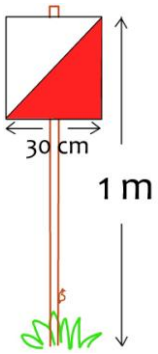
Individual increased size flags are not recommended.
If a control has flags at short and long distances, it is not necessary to double flag all flag positions, just those at long range.

Double flagging may also be used where there is poor visibility, such as flags in deep shadows viewed across brightly lit ground.

CONTROL FLAG HEIGHT

It is important that flags are hung at the same height in a control cluster where the height of the ground is significant but difficult to judge– on the far side of a hill, for example, where the ground level is not visible but assessed from the flag height. The example shows that Flags A and C are at the same height and on the contour. Flag B is higher up the hill.





It is recommended that flags are hung with the top of the flag 1m above the ground. The flag is then useful for judging the height of features, particularly relevant for those features that have a threshold height for being mapped. Examples are boulders and rock faces, which, if mapped exactly to specification, will not be shown if less than 1m high.

Flags can also be used for the estimation of small horizontal distances, using the apparent width of the flag as a guide. This does not vary much, between 26 and 30cm, depending on the rotation of the flag,

6. ZERO ANSWERS

The underlying reason for most dissent in trail orienteering is the existence of the zero control leading to the argument that, unless the flag is exactly in the right position, it is in the wrong position – zero! But how exact is exact? Debate about that continues.

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 wrongly be interpreted as a zero answer.

It may be thought desirable to state a distance or a percentage distance, beyond which a misplacement is deliberate. It is not technically possible to give an overall figure, as this depends on the terrain type, control feature and mapping accuracy. Providing separate figures for each control is technically possible but would require additional information in the description. This is not permitted under present Council guidance and Rules Commission instruction that TrailO and FootO descriptions should remain as current without further divergence.

However, research on the subject of tolerance for correct placement of flags and its implication for missing flags and zero answers continues and is likely to be discussed in a future Technical Note.

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. It is important to avoid small deliberate offsets in flag position planned as a zero answer which could be misinterpreted by competitors as being the result of sloppiness in placement and thus non zero.

There are two types of zero answer problem

Zero answers at non-flagged features:
There is no flag at the feature as defined by the centre of the circle and the control description. A useful form is the use of parallel features in which a section of terrain is near identical to a nearby section. Flags are carefully placed to represent a legitimate problem but the control circle is in the parallel terrain nearby. This form of problem can be surprisingly testing. Another common form is in complex terrain with many flagged features matching the control description but the circled feature has no flag

This latter form is the type of zero answer problem most suitable for tempO controls.

Zero answers at flagged point features:
These are point features where there are flags, but that is not in the position described by the control description. The possibility arises because, for point features, the centre of the circle is centred on the map symbol, yet the flag position is offset. In PreO this type of problem can be used down to quite small flag separations.

This type of problem, in its simplest form, may also be used in TempO competition

- **Zero answers at point features are acceptable in PreO competition to a precision of minimum separation of 45^{o} between directions (i.e. to distinguish between W and SW), provided that the feature can be sighted in these directions** ***(TG 24)***

- **Zero answers at point features are acceptable in TempO competition but only when there is a minimum separation of 135^{o} between the flag position and description.** ***(TG 25)***

A useful guide for competitors at zero answer controls which have been properly set is that, if they are not sure it is zero, then it is probably not zero.

7. 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.

The competitors' viewpoint

Controllers act on behalf of the competitors when judging and correcting control sites prepared by the Planner. This assessment must, initially and finally, be carried out when viewing from the trails. As soon as controllers step into the terrain, they gain additional information that is not available to the competitors. There are frequently good reasons for accessing the terrain, adjusting the fine detail of the map to better reflect that visible from the trail, for example.

It can be useful, if more that one controller is appointed to the competition, for one controller not to enter the terrain when a control site is being adjusted, so as better to judge from the competitors' viewpoint.

How long is the course and what time is allowed?

A PreO course should not be too long. The shorter the course the greater proportion of the allowed time can be spent on solving the problems and there is a saving of energy on moving long distances, important for competitors with physical limitations. If there is a long distance between controls an untimed break over that section is worth considering. The maximum time should not exceed 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.

In FootO normal practice is for the climb not to exceed 4% of the total distance. In TrailO the following is recommended:

Additional climb in trail orienteering is that:

- **in the Open class more than 2% of the course length,**
- **in the Paralympic class more than 1% of the course length,**

The extra climb is awarded a time allowance of 3 minutes for each 10 metres of height. ***(TG 21)***

Example: 2 km course with 18 controls and 60m of climb has 20m extra climb for Open class and 40m of extra climb for the Paralympic class

Time (Open class) = (3 x 18) + (3 x 2000/100) + (3 x 20/10)
= 54 + 60 + 6
= 120 min
Time (Paralympic) = (3 x 18) + (3 x 2000/100) + (3 x 40/10)
= 54 + 60 + 12
= 125 min

There may be other reasons for increasing the allowed time, particularly for wheelchair competitors on narrow, uneven or loose surface tracks.

The Event Advisor has the authority to make such allowances in accordance with the Rules.

The target time can be set up to a rounded figure that facilitates the competitors' calculations of their remaining times. For example, a 118 min time can be rounded up to 120 min. Simplified arithmetic may be considered useful for competitors not given a start time until they have cleared initial time controls.

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**. ***(TG 22)***

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 23)***

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 the 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.

A common difficulty with sighting lines is when there are too many! In areas such as parkland with many individually marked trees or urban spaces with many buildings there may be very many sighting line possibilities and it is likely that they will not all agree. Such areas are best avoided but, if used, the most important sighting lines should be identified and give a common answer.

The sighting lines have most merit when they intersect each other or cross a linear feature at an angle at or close to 90 degrees. Those that intersect at a shallow angle are most susceptible to error.

A very advanced sighting line use is when the line does not cross the control position but is to one side. The skill then required is to estimate the offset on the map and judge the equivalent distance in the terrain. Problems solved in this way have to be very carefully set.

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 in 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.

Unmapped and part-mapped features

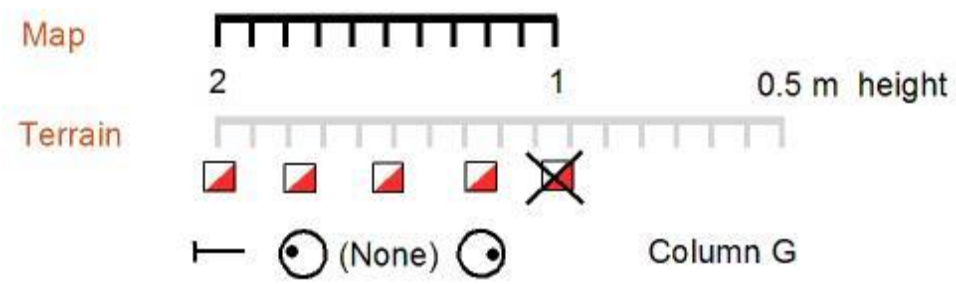
The mapping threshold for size of features for including them on the map can produce problems, especially for linear features. The minimum height or depth of features to be included on the map is given as 1m in the mapping specifications ISOM 2000 and ISSOM 2006. The mapper may choose, if the terrain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

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.

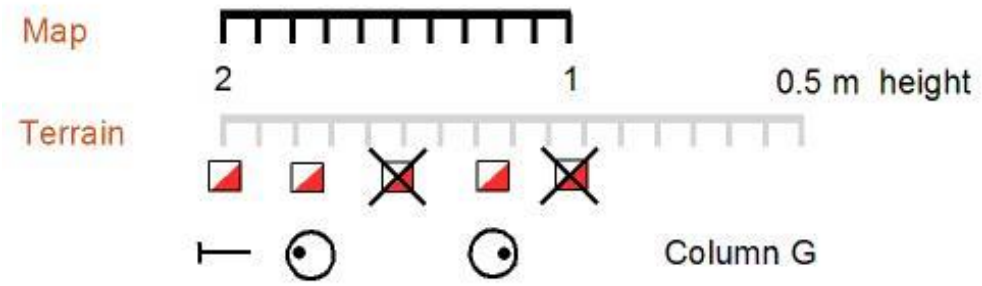
Consider the example of a rock face which is well above the mapping threshold of 1m at one end but reduces to below 1m at the other end. Only that part of the rock face which is 1m and above should be mapped. The planner needs to determine whether this is the case and confirm that a competitor viewing 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.

Caution should be exercised with 'A' flags that are well to the left of the main flag cluster. Such flags can lead to competitors identifying the correct flag but mistakenly labelling it. If a well-to-the-left flag is used, it is essential that it is an initial viable option with the correct description to give the flag legitimacy.

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.

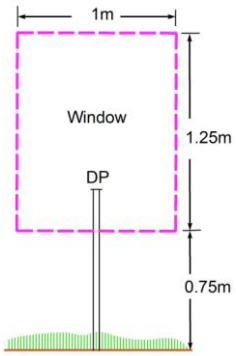
In the interests of wheelchair users the decision point should not be located on a steep slope.

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.

Where two or more viewing points are close to one another, it may be appropriate to have a combined recording point with individual punches placed together or just a single punch for all controls.

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.

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 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 2012.

For singly-presented maps the competitor has 30 seconds in which to give an answer. When there are 1-2 tasks on a station a warning is given when 10 seconds remains of the total available time for the station. When there are 3 or more tasks, a warning is given when 20 seconds remains of the total time for the station. The method of answering is either by pointing to a letter or stating the answer using the International Code: Alpha, Bravo, Charlie, Delta, Echo, Foxtrot or Zero.

New rules for PreO came into force in January 2014 with the following changes:

- In PreO competition, each correctly identified control (excluding Timed Controls) scores one point.
- In PreO competition the timed controls are used as tie-breakers to rank competitors with the same points score.

When analysed on completion of the course the correct answer at a timed control is awarded no point and the time recorded is the average of the two measurements, to the nearest half or full second. An incorrect answer gains a 60 second penalty added to the time taken to answer. Failure to answer is given a time of 90 seconds.

For multiply-presented maps the timing starts at the sighting of the first map and stops when the answer is given for the final map.

A more detailed description of the timed control procedures is given in Appendix 2.

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 unfairly 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 5-10 seconds.

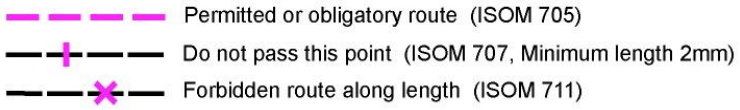
- **The zero answer option is not suitable for timed controls in PreO trail orienteering competition.** ***(TG 26)***

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

If the timed control flags are wide spread across the field of view, it may be useful to place limit of view marker tapes in the terrain.

Marking of permitted and forbidden tracks

In TrailO competition there is often a need for competitors to enter or cross terrain that is not marked as a path or track as part of the planned course. Such a permissive or obligatory path is marked in the terrain by marker tape, either continuous or at intervals, and on the map by dashed purple line:



Also in TrailO competition there are often a number of paths and tracks that shall not be used by the competitors. There are various reasons: they may not be suitable for wheelchair users; sometimes paths are forbidden to prevent the control site being

viewed from a different direction; there may be a need to prevent unfair physical advantage from the young and fit running several hundred meters to get a better view to solve the control problem.

As the diagram shows, there are two representations for forbidding paths being used. The purple 'do not pass this point' bar on the map is the smaller symbol and may be preferred if the map is congested. It is repeated on the ground with tape across the path at the same point. This placement can be very precise, if needed, to define the extent from which the control site flags can be viewed.

The other representation is more general and indicates that the path along its length is forbidden.

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 are:

- either a set of map segments cut, enlarged to twice map scale (or more for very 'tight' flag placements) and pasted onto a single, usually A4, sheet;
- or a map of the whole competition area, again normally twice scale. This map is very large compared with the competition map and without additional enlargement for tight controls.

In each case the maps show 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 are the descriptions for the time controls.

It is important that the solution sheet mapping agrees exactly with the competition map. Late changes to the competition map that 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 these symbols can be retained for making up the solution sheets. Before printing the competition map the special symbols must be hidden!!

Of the two solution map options the segmented maps take more effort to produce and are at risk from late changes to the competition map but have more flexibility in presenting the solutions. The general preference is for segmented solution maps.

A solution map example is given in Appendix 4.

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 that 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 FootO this can be done without voiding the whole course.

However, the voiding of 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.

The procedures for complaints and protests are given in the Rules.

Off-trail is off-limits

It is important that the Organiser makes it clear that at no time on the day that an event takes place (**including the Model event**) shall any competitor or official go off-trail to investigate control sites. By 'off-trail' is meant off permitted paths and marked routes. Since all TrailO controls are planned to be viewed from permitted trails, and the event controller/adviser has confirmed their acceptability, investigation of the terrain by moving off-track is not necessary, likely to confuse and unfair practice.

The Organiser is permitted by the rules to allow access to the competition area after an event closes but this does not allow movement into the terrain off the permitted trails.

8. 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

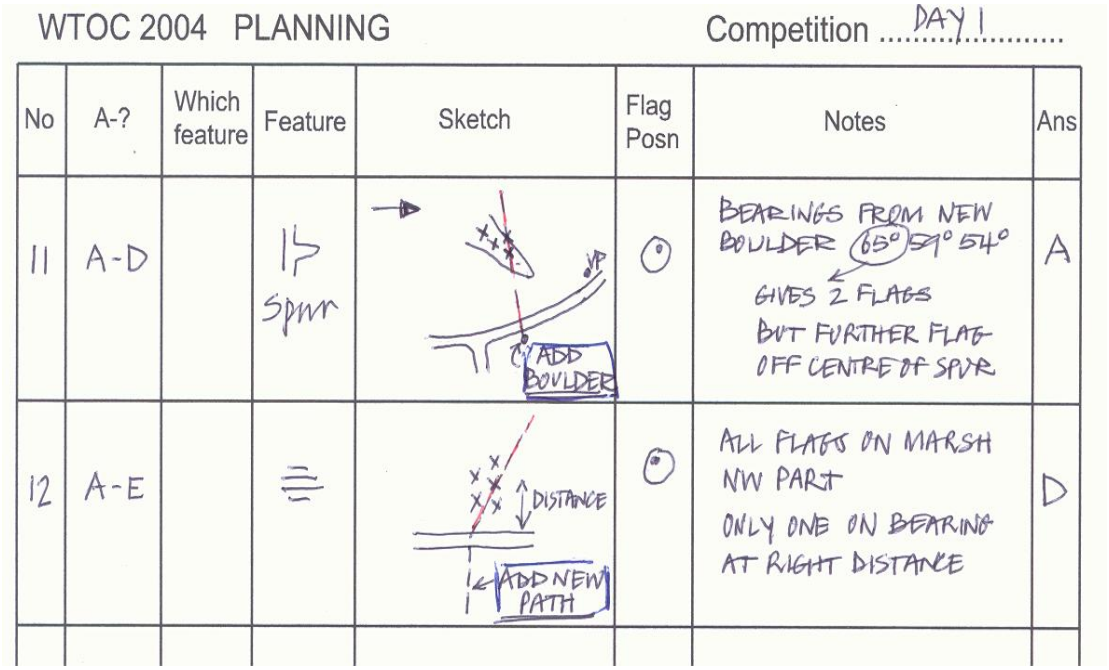
necessary, to give acceptable visibility round the control sites. However, it should be confirmed, by visiting at the correct time of the year, that seasonal vegetation does not make the area unusable.

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	ADD BOULDER		BEARINGS FROM NEW BOULDER 65° 59° 54° GIVES 2 FLAGS BUT FURTHER FLAG OFF CENTRE OF SPUR	A
12	A-E			DISTANCE ADD NEW PATH		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 are the final checks, 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 preO competition and one day of championship tempO, four days should be set aside for checking. This includes, for each event, the final draft of the course map, the final draft of the solution map, every 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.

Once the above checks are confirmed as satisfactory, or any **essential** last minute corrections made, the maps can be printed.

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 often found at this stage, despite very careful preparation. If found two days or so before the competition, there is time to put them right. Last minute 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.

9. DOCUMENTATION

The 2008, reissued 2009, 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.

This extensive revision (January 2014) has been prepared by B-HP, assisted by the other members of the Guidelines Revision Working Group:

Ivo Tišljar (CRO)
Martin Jullum (NOR)
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Krešo Keresteš (SLO)
Bohuslav Hulka (CZE)
Remo Madella (ITA)

to whom a thousand thanks are readily given.

In general the suggestions made by the Working Group have been incorporated into the new text and diagrams. Where there was not consensus about a suggested change the final decision was taken with the assistance of Martin Fredholm. Martin also carried out the proof reading of the document with impressive skill and deserves double thanks.

For those wishing to translate the document into other languages, the document is available other formats. Also available are the OCAD files of diagrams with text.

Much useful material is available from the IOF web site www.orienteering.org. The TrailO documents page gives access to other technical documents.

APPENDIX 1

PLANNING EXAMPLES for ELITE TRAILO

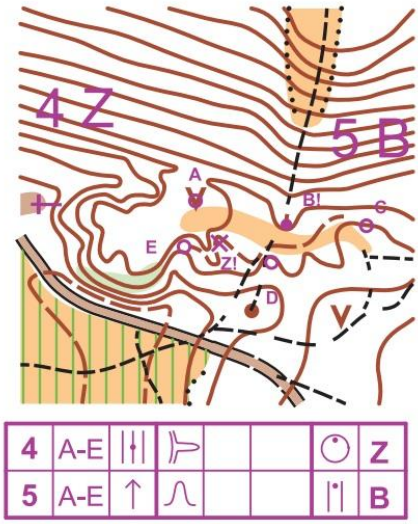
There is a wide range of different problems that can be set by TrailO planners to give elite TrailO competitors the necessary variety and technical level of challenge.

The examples given here are from World Championship events and can be added to in due course.

Zero examples are not given in a separate sub-section but are included, where appropriate, in the use of the different techniques.

A TempO sub section is included.

Classic contouring



Example: PreO WTOC 2013, Finland, Day 2-4/5

A complex contour area with overlapping controls, in this case the 5 flags giving two problems.

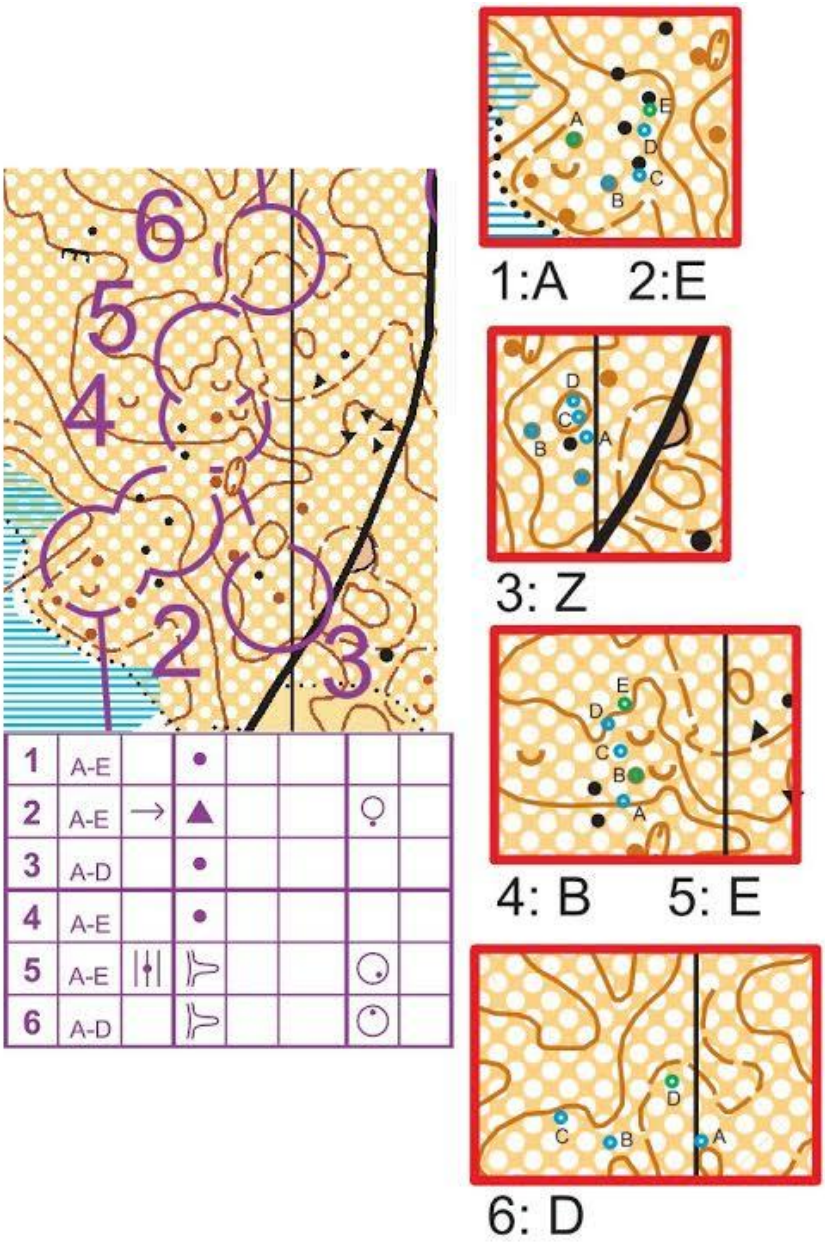
The zero control was testing.

Complex control clusters

Example: PreO 2: ETOC 2010 day 2:

This shows full use of a detailed semi-open contour area with 18 flags providing 6 control problems, two pairs of overlapping A-E controls and two standalone A-D.

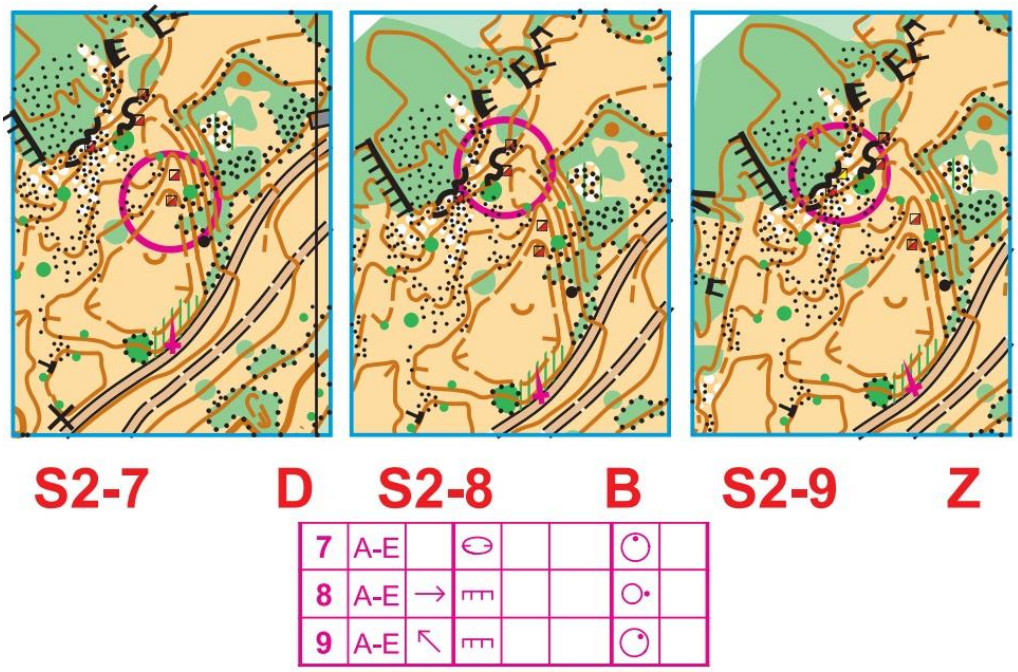
The flags were placed on mapped and unmapped features. Marker tapes separated the clusters, as necessary.



Another example of complex control cluster

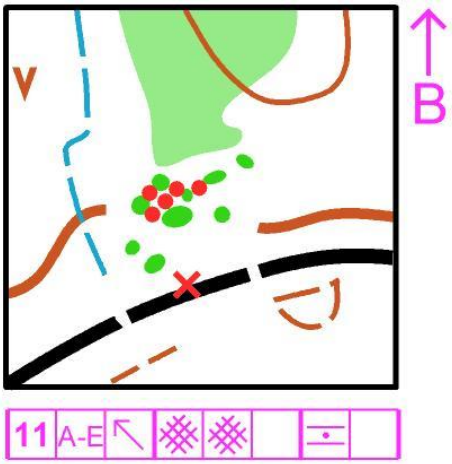
PreO WTOC 2011, France

Three control problems from five flags. The three solution sheets are easy to interpret but locating the centres of broken circles on the competition map required care.



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.



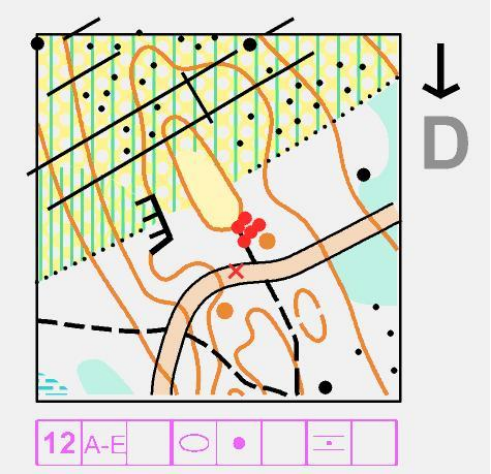
Example: WTOC 2005, Japan, Day 2-11.

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 the following example.

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

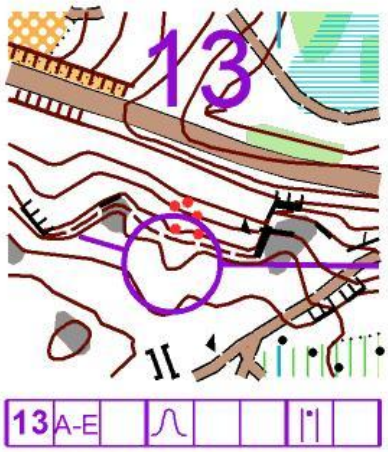
The difficulty here is in identifying exactly where the contour line was with respect to the ground. In this case the contour coincided with the open yellow. This indistinct vegetation change helped to locate the contour line. The dot knoll had a reasonably clear foot so it was possible to determine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

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.

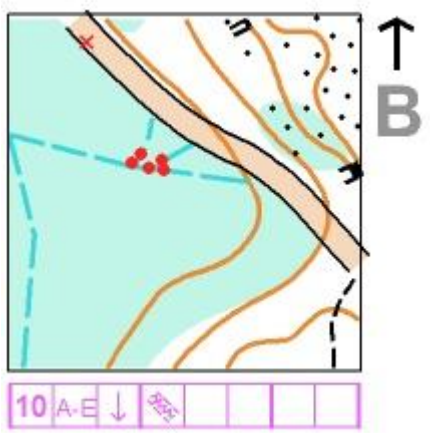
A more straightforward option for using an invisible feature is the zero answer in which all the flags are clearly identifiable on other features, as with the following example:



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, Swede,Day 2-10

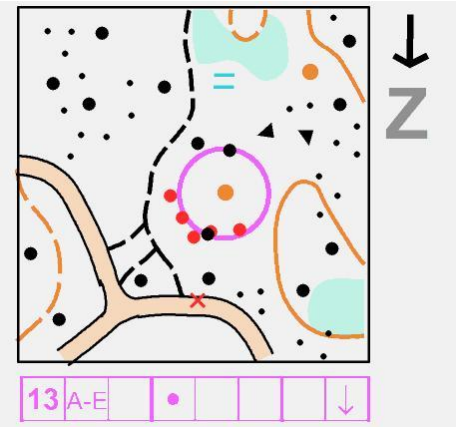
None of the ditches were visible from the viewing point. However, each ditch was visible when viewed along its length. By sighting along the three ditches in turn, it was seen that all flags were marking ditches and the correct flag, just east of the E ditch junction could be identified.

Unmapped features *(including zero control example)*

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 that are prominent enough to be mapped. Perhaps the most common, but usable feature, is the small boulder, but there are other possibilities.

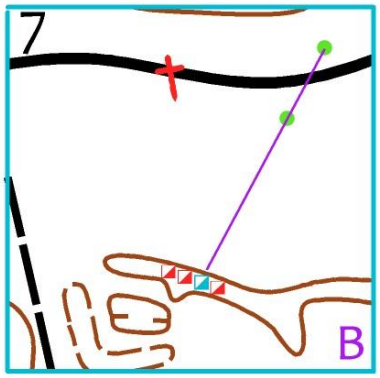
Example: WTOC 2004, Sweden
Day 2-13

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 2012, Scotland
Day 1-7 Spur, W part.

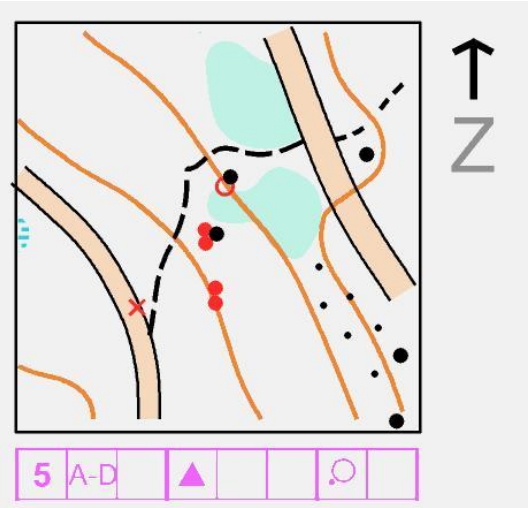
Once the two small holly trees had been seen as providing a sighting line to the centre of the circle (blue flag) the practical skill required was to locate the sighting line in the terrain, with one leading mark behind and one in front..

Displaced similar features *(including zero control examples)*

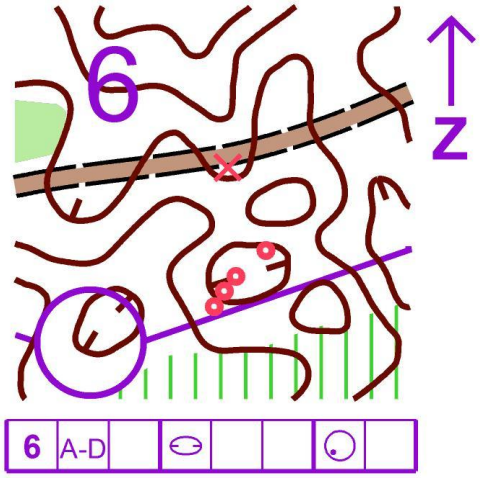
The existence of two or more displaced or **parallel** similar features can be used to set testing problems. The intention is to invite misidentification of which feature is which. These normally are set to give a zero result, the correct feature being unmarked with the parallel feature(s) being flagged.

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

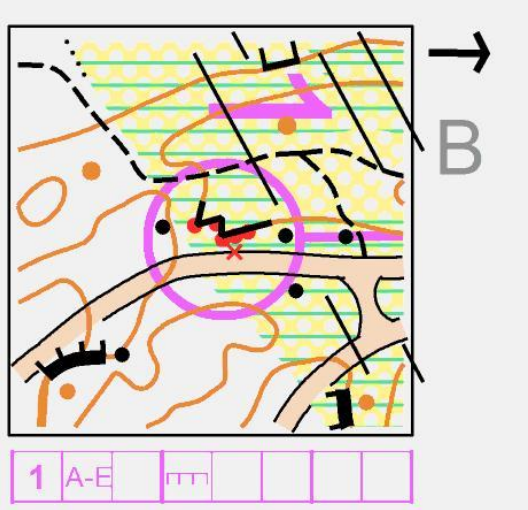
The approach from the west had a number of repetitions of the re-entrant and spur combinations, all with pockets of denser vegetation on the north side of the track. The false depression was surrounded by higher ground which, at first sight, matched that mapped round the correct depression. This control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

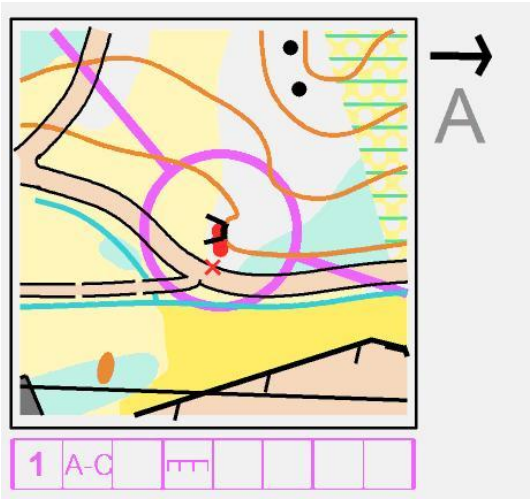


precisely indicates this SE corner and eliminates the distractor flag E at the mid-point of the SE face.

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

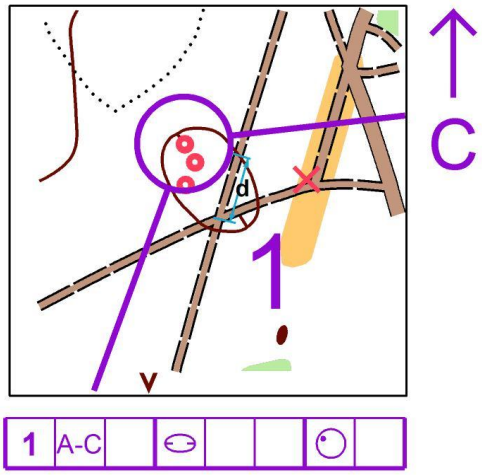
But the last control on the same day, D1-18, also a rock face, was much more difficult.

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

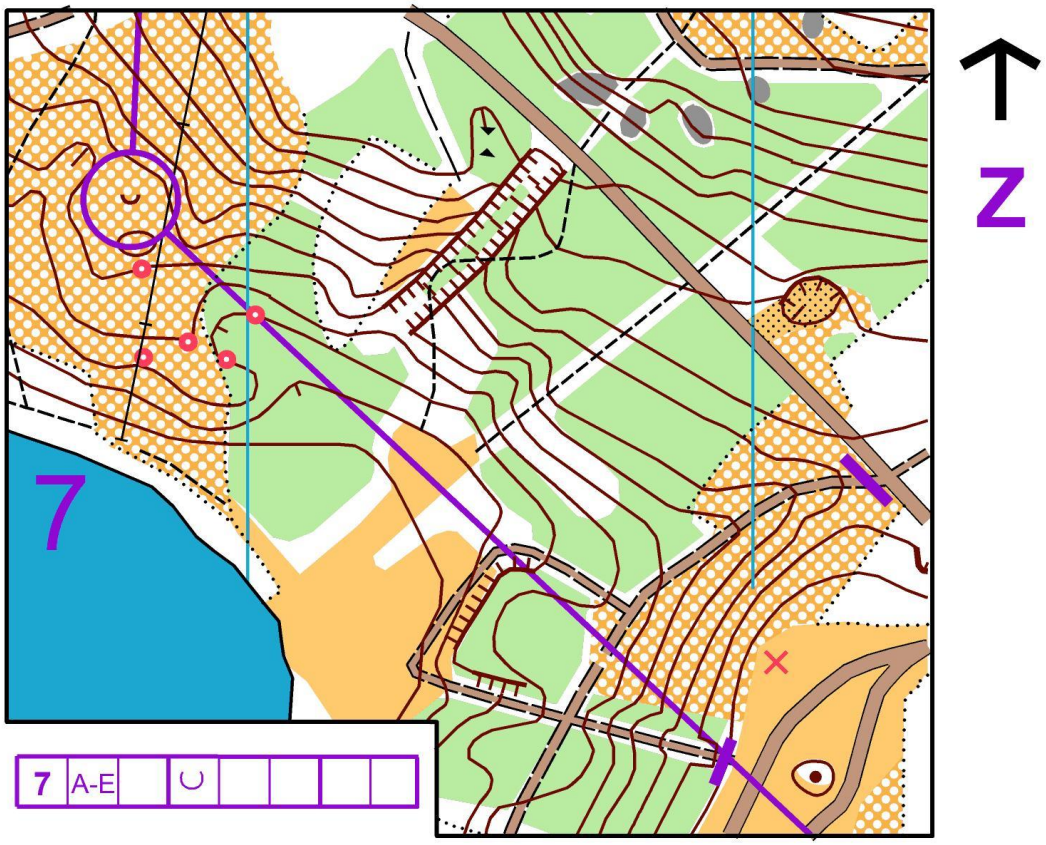


Example: WTOC 2006, Finland
Day 1-1

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 *(including zero control example)*

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.

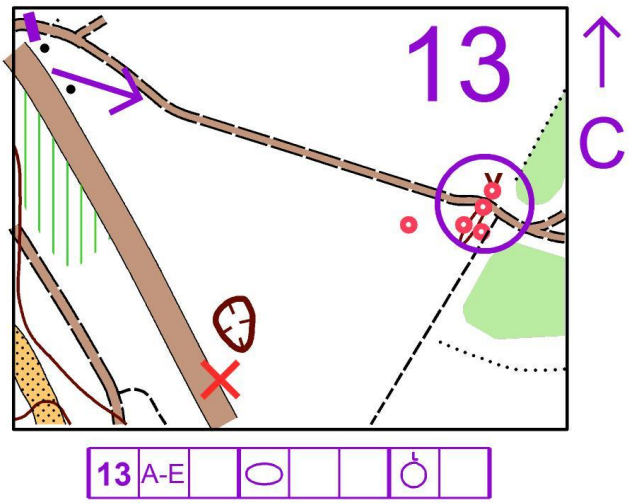
Although this problem was only of moderate technical difficulty, it demonstrates that, with care, long range problems can be set up successfully.

Parallax

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

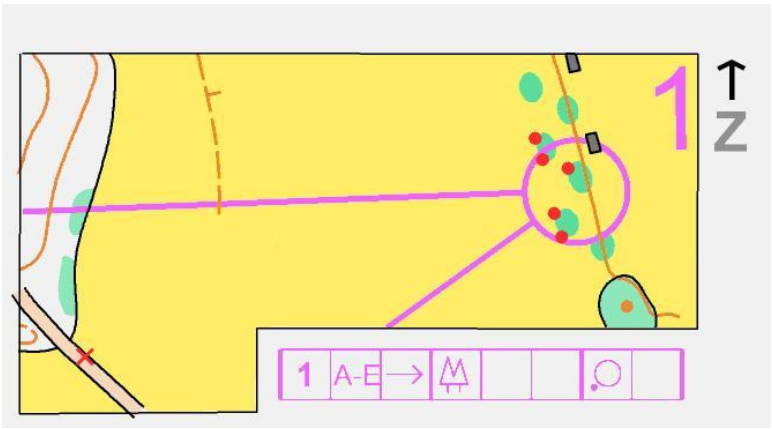
This property is used in elite trail orienteering when the sighting point from which the correct flag is decided is distant from the staked viewing point and the relative sequence of the flags is different at the two points. It demands skills of identifying the same flag in the terrain when viewed from 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.

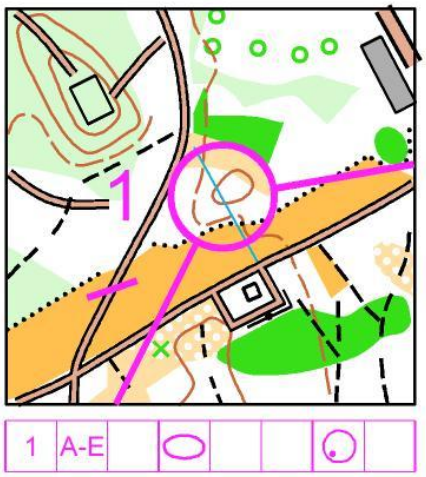
The principle of parallax can be also used to separate nearer and further features which are some distance away and tend to merge together. Viewing the features while moving along the track identifies those which are in front of the others.



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.

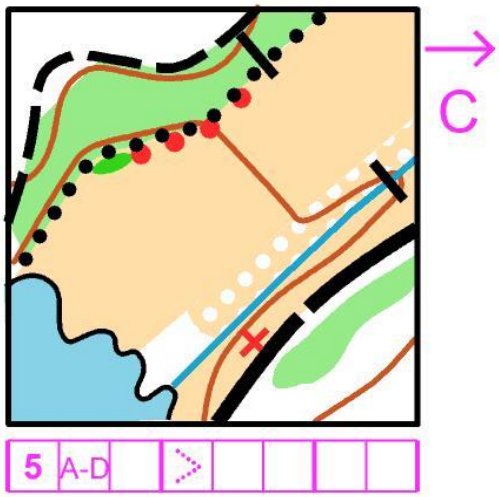


Example: WTOC 2007, Ukraine, Day 1-1.

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

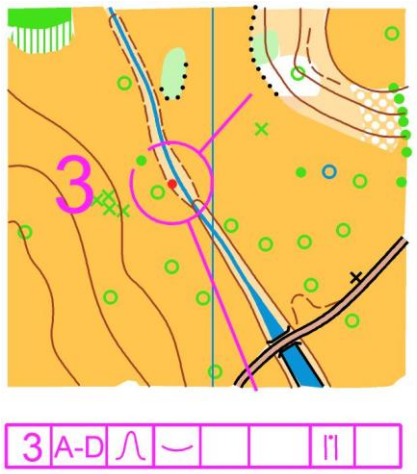


Lateral distance across the terrain can be estimated accurately, provided there are mapped features at the same range that can act as a base line.

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

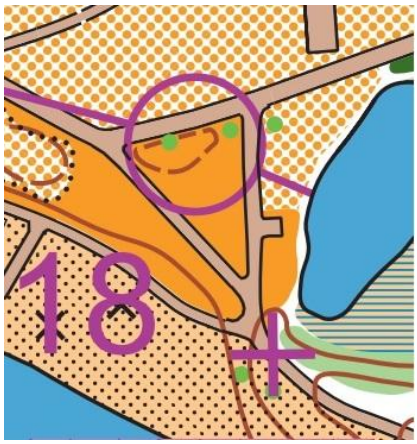


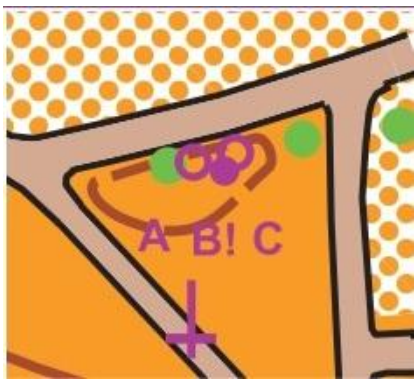
Area features defined by lines with very shallow curvature, as in the following example, may be considered as linear features.

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.

High accuracy precision control





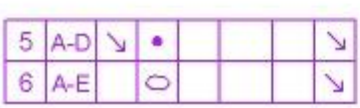
Example: WTOC 2013, Finland, Day 2-18.

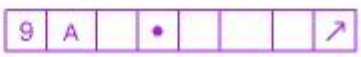
This is a high accuracy problem with flags close together, requiring the ability to locate the centre of the circle with precision on the map and then in the terrain.

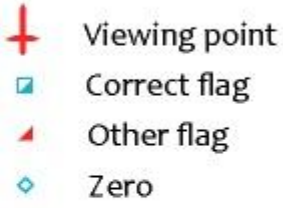
The key to the solution was with the two trees. Sighting the three flags from the viewing point ruled out flag A as being too close to the W tree. By viewing from by the S path junction so that the line between the trees was at right angles to the direction of sighting, it could be seen that flag C was midway between the trees. From this viewing point flag B appeared to be correct. It was then necessary to confirm that flag B was offset from the line between the trees by the distance estimated from the map, which it was.

An alternative method of determining the position of flag B between the trees for competitors prepared to do the arithmetic was to measure the map distances along the track. Since the trees were close to the path, pacing along the path could have the required precision.

'A'' control in the presence of other flags *(including zero control example)*



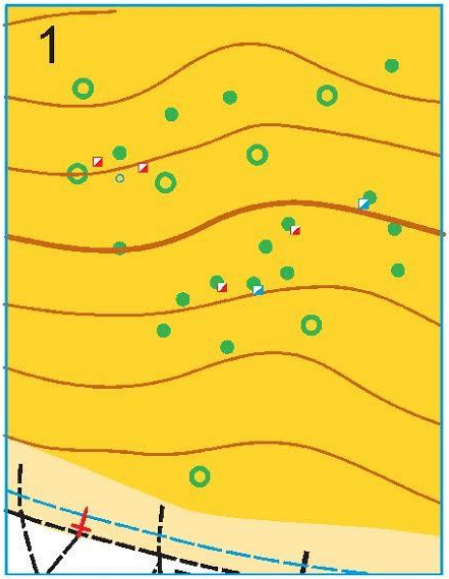




Examples: WTOC 2012, Scotland Day 2

The terrain carried mid-age pine trees restricting visibility:
For Control 5 only the four NE'most flags were visible from the viewing point.
For Control 6 all nine flags were visible so tapes were laid.
For Control 9 only the five flags shown on the map were visible.

SOME TEMPO EXAMPLES

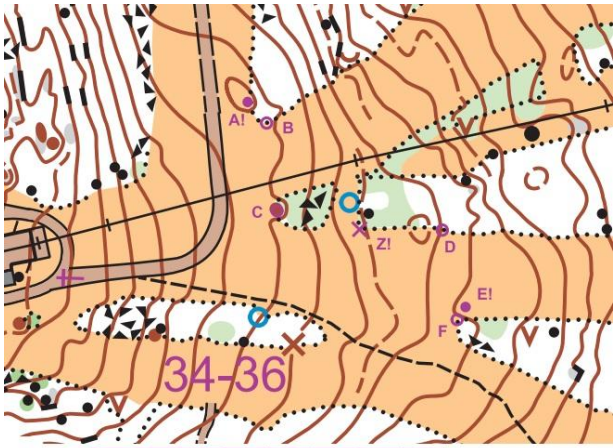


1	A-F	↓					Z
2	A-F	↖					F
3	A-F	↓					E

Example: TempO WTOC 2012, Scotland, 1-3

This is a map very easy to read, with negligible contouring and a considerable number of individually mapped single trees, some fully mature and the remainder much smaller. All three control problems referred to trees. The problem of identifying which tree was which was assisted by the large trees having a different symbol.

This trio of control problems would be easy for PreO but is well suited to TempO.



34	A-F						E
35	A-F						A
36	A-F						Z

Example: WTOC 2013, Finland,. TempO final, 34-36

This is a more featured map with four readily identifiable blocks of forest, three of which were associated with the controls. In each case the right block of forest had to be identified and the choice made between two flags or zero.

The terrain sloping down made the re-entrant less obvious but the reduced height of the flag confirmed its position.

A good TempO combination of different features.

Example: TempO WTOC 2013, Finland,
TempO final 31-33

A difficult set of controls at very short range (note the greatly enlarged solutions map). The map of rocky knolls and bare rock is much more difficult to interpret quickly that the example from Scotland.

A testing set appropriate to a World TempO final.

31	A-F	↘	•				E
32	A-F	↖	•	•			A
33	A-F						C

APPENDIX 2

TIMED CONTROL PROCEDURES

1. Purpose of timed controls

In the PreO form of trail orienteering the time controls are used to separate competitors with the same point scores for correct answers. The number of timed controls, additional to the main course, is usually 2-4 in number. The competitor with the fastest overall corrected* time at the timed controls for any particular final score is ranked above slower competitors with the same score.

*Incorrect answers or failure to answer at timed controls incur time penalties, which are added to the actual time taken to give the corrected time.

In the TempO form of competition all the controls are timed. In such competition there are several stations and many controls. The competitors are ranked for the competition by their corrected overall times for all the controls.

2. Timed control maps

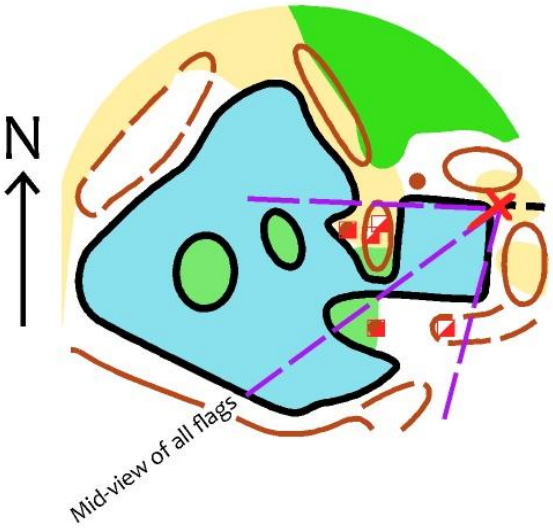
A timed control map differs from the main competition map, from which it is often extracted as a segment at the same scale. This segment is rotated so that the middle top of the map is in the centre direction of view of the control flags. Magnetic north direction is added.

The map, at its centre, shows a single control circle, together with a description. The map does not mark the viewing point.

To ensure fairness at time controls, where as little as a second can separate competitors, it is important that the maps are standardized in form and appearance. The Rules specify the basic requirements and are repeated here with additional comment:

- The time control map is placed on a rectangular piece of stiff material.
- The map segment is either circular or square with diameter or side between 5 cm and 12 cm. If a square map segment is used the sides are parallel to the material the map segment is put on.
- The control circle for each control is marked at the exact centre of the map segment.
- The viewing point of the seated competitor is within the map segment but not marked on the map.
- The map segment is oriented so that its vertical is at the mid-viewing angle between the A-flag and the furthermost flag on the right. **This angle is the same for all controls at the same time control station**. See the illustrations below.
- The time control map and procedure should be modelled before the competition to allow the competitors to confirm the arrangements.

Preparing timed control maps:



These are from WTOC 2012 but re-drawn to comply with 2014 rules and practice.

1. On a conveniently enlarged map of the timed control area, mark the position of the control flags visible from the timed control station. In this case there were five flags visible from the viewing point near the water's edge at the end of the path.

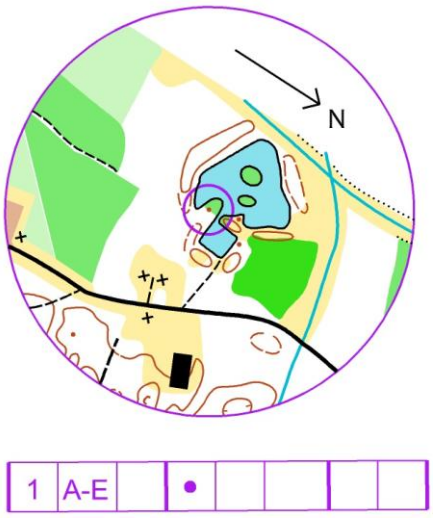
2. Determine the bearing of the line bisecting the angle of view between the A-flag and the furthermost flag on the right. In this case the bearing is 245°.

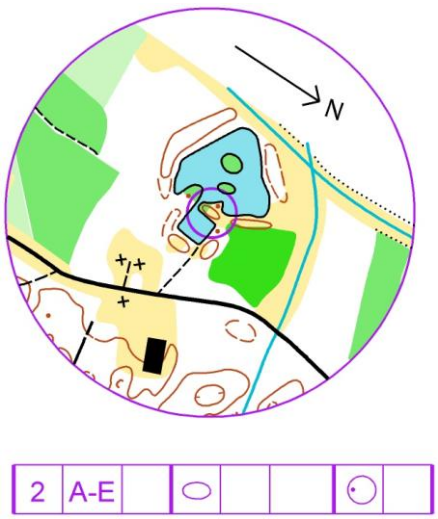
3. Rotate the timed control area map (at competition scale) by this bearing. The mid view of all flags should now be vertical, bottom to top.

4. For each control, position a square or circular template of between 5 and 12 cm side or diameter so that, in each case, the control circle is at the centre of the segment.

5. Extract the segments, add the descriptions and a north arrow, then print.

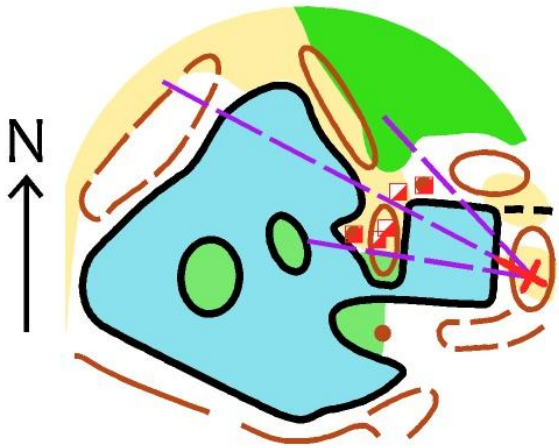
6. In the two timed control maps for this station (Paralympic, Day 2) it can be seen that the background map has moved but maintained the same direction for magnetic north:





It might be asked why this single rotation of the map, followed by vertical and horizontal movement to bring the control circle to the centre of the segment, is preferred to rotating the map separately for each control so that the control and viewing point are in line up the vertical middle of the segment, followed by vertical shift to place the control circle at the centre. The answer is that, with the map set at a fixed angle throughout, there is consistency on the map segments with any Column G directions given in the descriptions.

It is instructive to note that the same site had two stations in close proximity. The second for the Open class, giving a total of seven flags overall, but only five visible from each station. The enlarged map shows the very different mid-viewing angle, around 297^{o}.



The northernmost two flags were not visible from the Paralympic class station because of the lie of the land and intervening poolside vegetation. Similarly, the southernmost two flags of the seven were not visible from the Open class station, the knoll obscured by vegetation and the form line spur flag was set behind a tree.

These examples from PreO competition had only five flags in view, with two timed controls per station and NO zero answers.

TempO stations usually have six flags in view, with at least three controls per station. Zero answers ARE permitted.

3. Basic requirements of timed controls procedure

3.1 At a **single** timed control the competitor is given a map with a cover sheet and introduced to the terrain. Immediately following this the timing starts. The map has a control circle and description.

The competitor reads the map, surveys the terrain and gives an answer. The timing stops.

Two watches are used. Both times and the answer are entered on a record sheet and repeated on the competitor's control card.

3.2 At **multiple** timed controls the maps are handed out as a set and the timing is from the start until the last answer.

This procedure is used in both PreO and TempO. The earlier form of presenting the maps one at a time and timing them separately has now been superseded.

4. Typical detailed procedure at a timed control station

It is usual to view the terrain and flags from a shelter.

In the shelter, over the viewing point, there is a chair. For wheelchair users the seat is placed to one side and the wheelchair manoeuvred into position over the VP marker.

The normal staffing is for three officials, the recorder plus two timing officials. It is possible, but more difficult, to manage with two officials by overlapping duties. Two is a minimum, four is fully staffed.

A timed control at WTOC 2008. Seated competitors have the same view as those in wheelchairs.

The competitors are held at a stop point some distance away, from which they cannot see the control terrain and flags. They are brought forward in turn. The fourth official can be usefully employed for this but an alternative is to place a suitable notice at the stop point and the recorder or one of the other officials calls the competitors forward.

As the competitor comes into the shelter the control card is handed over. The competitor's details (name and number) are entered into the record.

At least one timing official stands in front of the chair to block the view of the terrain and flags while the competitor settles.

Once settled, the competitor is handed a single or set of maps with a cover sheet. Then the competitor is introduced to the terrain with a standard routine. The officials step aside and one of them points out the outermost flags: **Alpha** and **Echo**, if five flags are in use, or **Foxtrot**, if six flags are in use (as permitted in TempO).

Competitors are not allowed to slow this process by saying they cannot see one of the flags. Sometimes flags can be difficult to see quickly and easily (shadow, flags at very different heights or distances, etc). In these cases the official shall add additional information to precisely indicate flag positions to competitors, such as “far away”, “beside …”, “behind …”. The official’s statement shall be the same for all competitors.

Equally the competitors are not allowed to speed this process by saying they see all the flags without them being pointed out. The pointing procedure is a ritual to give the same viewing time for each competitor.

Immediately following the pointing out of the last flag the official invites the competitor to view the map(s) with the words **the time starts now.**

For one map (3.1 above):

The competitor gives an answer. The **timing stops** and the map is taken from the competitor.

An answer is given either by speaking, using the International Phonetic Alphabet “**Alpha** to **Echo**, (or **Foxtrot**)” or by pointing out the letter on a pointing strip, or both. The pointing letters may be on a separate card, on a trestle in front of the competitor or, as in the photograph, on the map board.

Times are measured using two timing devices.

The answer is repeated by the recorder and entered into the records, together with the two times, each rounded down to completed seconds.

[The reason the recorder repeats the answer is to confirm the selection and avoid problems of pronunciation.]

The competitor is given a maximum of 30 seconds to give an answer. A ten-seconds-to go warning is given at 20 Seconds.

For several maps together (3.2 above):

The competitor is given a set of maps in order. It is essential that the maps have prominent sequence numbering that can be checked by the officials before being handed to the competitor AND by the competitor before timing starts. A recommended method of sequence marking is given in Appendix 4.

The competitor considers the problem on the **first map** and gives an answer. This answer is repeated by the recorder and entered into the records.

Without delay the competitor considers the problem on the **second map** and gives an answer, which is repeated and recorded.

In like manner, the competitor continues to the **last map** and with the final answer, the **timing stops.**

In multiple map timing the maximum total time allowed is 30 seconds multiplied by the number of timed controls. If there are two timed controls, a ten seconds-to-go warning is given at 50 seconds. If there are three or more timed controls, a twenty seconds-to-go warning is given when 20 seconds remain of the maximum allowable time.

Competitors must follow the map order and deal with each map without reference to earlier or later maps.

Finally … Whatever system is in use, the answers and times are copied onto the competitor's control card and the competitor departs the control station.

5. Screening

There can be problems with visibility of the timed control terrain for competitors approaching the viewing position after being called up. In these cases some form of screening may be required to interrupt the view.

In recent years there has been a trend by Event Advisors to require complete (100%) screening of the timed control terrain on the approach. To accomplish this in the forest some federations erect temporary 2m fencing covered with opaque polythene sheet. Other federations cannot do this without objection from environmental organisations (refer to IOF Environmental Charter). A recommended alternative is to use a string of national flags, weighted along the bottom edge. Experience has shown such an arrangement to be fully effective and acceptable to those with environmental sensitivities.

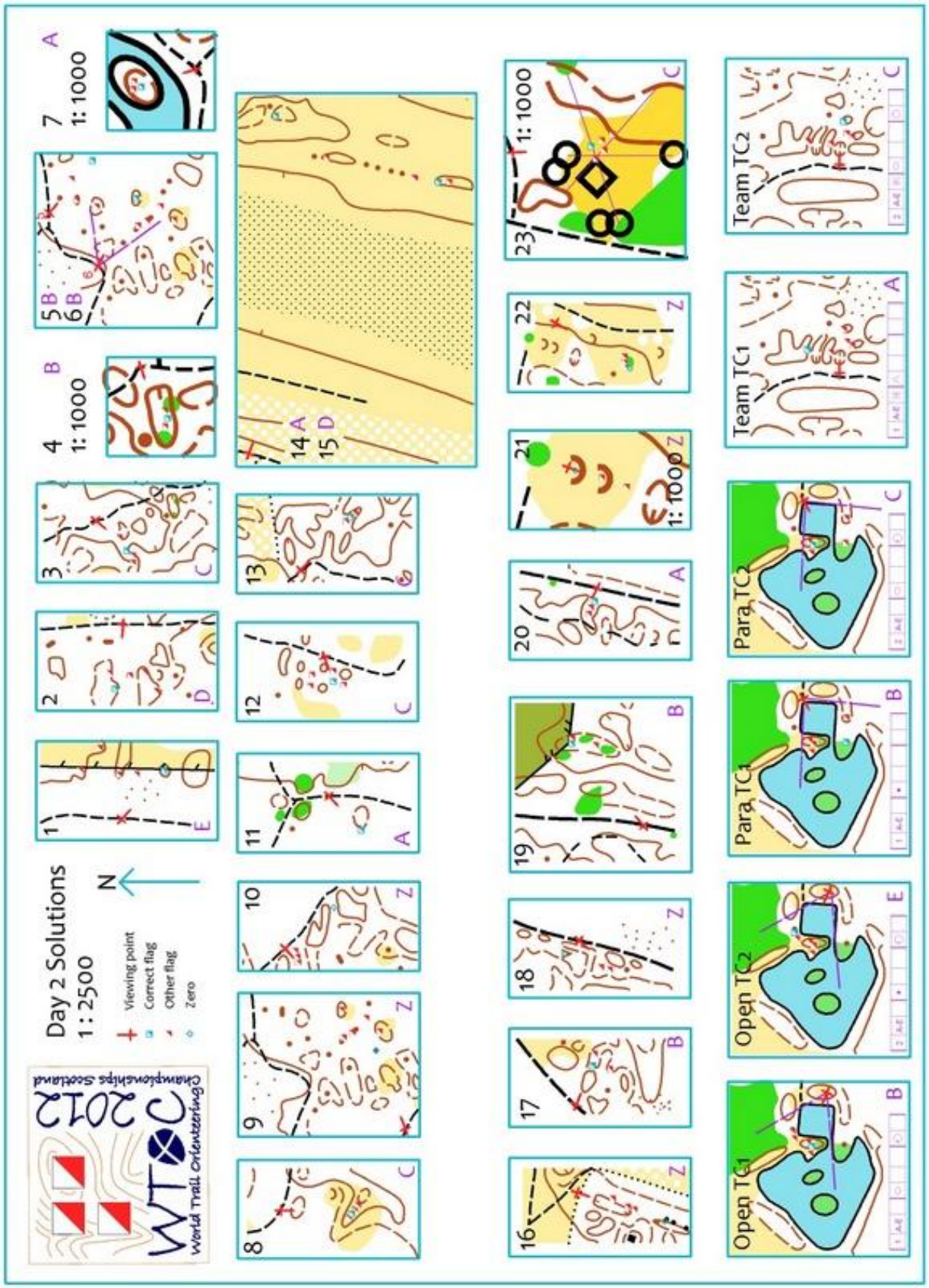
The approach

'Your time starts now' *from WTOC 2012*

4. Future development.

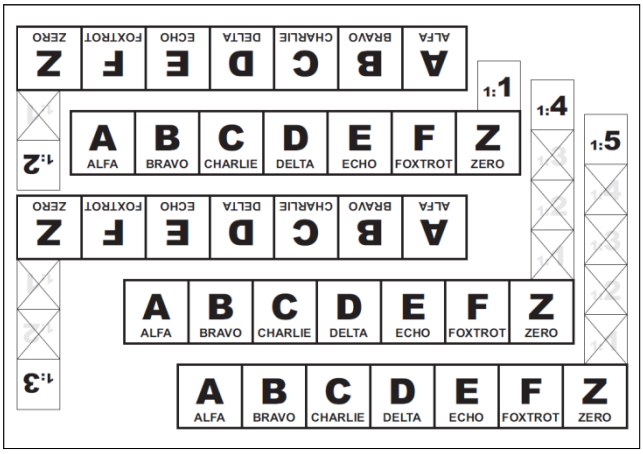
The system described here is that of manual timing and manual recording of answers and times. Currently (2014) electronic timing is being developed for trail orienteering. If and when approved for event use, new and revised procedures at timed controls will be issued.

APPENDIX 3 EXAMPLE OF SOLUTIONS SHEET From WTOC 2012 Day2

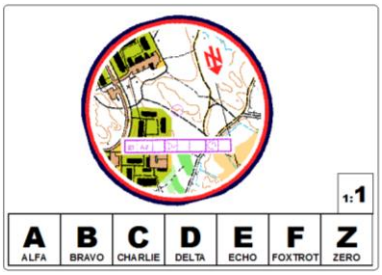


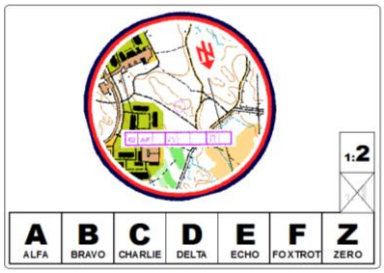
APPENDIX 4. A recommended method of sequence marking on time control maps

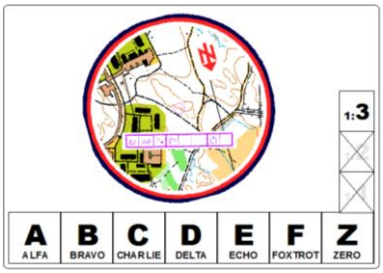
The picture to the right shows one page of a multipage document that can be downloaded from the IOF TrailO web pages. It contains templates with sequence markings that are useful when producing time control maps for PreO and TempO competitions. The document contains templates for ten stations and five controls at each station for both TempO and PreO (the latter with the zero square blacked out).



The templates are cut out and placed together with their respective maps as shown in the three pictures below. The outlines represent A5 clear plastic laminate that are used to fix the map and the template together.







Below are two sets of maps containing the maps prepared above plus a cover sheet. The three maps in each set are slightly offset from each other in the pictures just to show that they are all present.

In the left hand picture below, all maps are in the correct order 1-2-3, confirmed by the clear black sequence numbering. In the right hand picture, the maps are in the wrong order 1-3-2, easily seen by the crossed over square between 1:1 and 1.3.

This marking method makes it easy for both officials and competitors to reassure themselves that the maps are in the correct order before the timing starts.