RECOMMENDED MINIMUM CLASSIFICATION REQUIREMENTS
FOR HORIZONTAL CONTROL

TRAVERSE[1]

Classification ∏	Second Order	Third Order		State Statute
	Class II	Class I	Class II	236.15(2)
Relative Accuracy ∏	1:20 000	1:10 000	1:5000	1:3000
Types of Surveys ✡				
Primary Control *	**X**			
Secondary Control		**X**		
Alignment		**X**		
Supplemental Secondary Control (USPLS corners)		**X**		
Aerial Photogrammetry		**X**		
Right of Way				**X**

* Primary Control is normally established by GPS methods with an accuracy of 1:100,000.

[1] Other methods of establishing horizontal control, such as triangulation and trilateration, may be used in lieu of traverse methods. When other methods are employed, they shall conform to the appropriate section of the Federal Geodetic Control Committee publication, "Standards and Specifications for Geodetic Control Networks," as reprinted in October 1990, or subsequent revisions thereof.

Standards and Specifications for Horizontal Control

TRAVERSE

Network Geometry

Order Class	*Second II*	*Third I*	*Third II*
Station spacing not less than (km)	2	0.5	0.5
Maximum deviation of main traverse from straight line	25°	30°	40°
Minimum number of bench mark ties	2	2	2
Bench mark tie spacing not more than (segments)	10	15	20
Astronomic azimuth spacing not more than (segments)	20	25	40
Minimum number of network control points	2	2	2

Instrumentation

Order Class	*Second II*	*Third I*	*Third II*
Theodolite, accuracy*	1.0"	1.0"	1.0"

* standard deviation based on DIN 18723.

Field Procedures

Order Class	*Second II*	*Third I*	*Third II*
Directions			
Number of positions[1]	6 or 8[2]	4	2
Standard deviation of mean not to exceed	0.8"	1.2"	2.0"
Rejection limit from the mean	5"	5"	5"
Reciprocal Vertical Angles (along distance sight path)			
Number of independent observations dir/rev	2	2	2
Maximum spread	10"	10"	20"
Maximum time interval between reciprocal angles (hr)	1	1	1
Astronomic Azimuths			
Observations per night	12	8	4
Number of nights	1	1	1
Standard deviation of mean not to exceed	0.6"	1.0"	1.7"
Rejection limit from the mean	5"	6"	6"
Infrared Distances			
Minimum number of measurements	1	1	1
Minimum number of concentric observations/measurement	1	1	1
Minimum number of offset observations/measurement	1[3]	—	—
Maximum difference from mean of observations(mm)	10[3]	—	—
Minimum number of readings/observation	10	10	10
Maximum difference from mean of readings	[4]	[4]	[4]

[1] A position is one direct and one reverse observation.
[2] Use 6 if 0.2", 8 if 1.0" resolution.
[3] Only if decimal reading near 0 or high 9's.
[4] As specified by manufacturer.

Office Procedures

Order Class	***Second II***	***Third I***	***Third II***
Azimuth closure at azimuth check point (seconds of arc)	4.5 ÖN	10.0 ÖN	12.0 ÖN
Position closure ..... after azimuth adjustment[1]	0.20m ÖK or 1:20 000	0.40m ÖK or 1:10 000	0.80m ÖK or 1:5000

(N is number of newly measured segments, K is route distance in km)

[1] The expression containing the square root is designed for longer lines where higher proportional accuracy is required. Use the formula that gives the smallest permissible closure. The closure (e.g. 1:10 000) is obtained by computing the difference between the computed and fixed values, and dividing this difference by K. Note: Do not confuse closure with distance accuracy of survey.

Distance Accuracy

Order Class	***Second II***	***Third I***	***Third II***
Minimum distance accuracy[1].....	1:20 000	1:10 000	1:5000

[1] When a horizontal control point is classified with a particular order and class, this certifies that the geodetic latitude and longitude of that control point bear a relation of specific accuracy to the coordinates of all other points in the horizontal control network. This relation is expressed as a distance accuracy, 1:a. A distance accuracy is the ratio of the relative positional error of a pair of control points to the horizontal separation of those points.

A distance accuracy, 1:a, is computed from a minimally constrained, correctly weighted least squares adjustment by:

$$a = d/s$$

where: a = distance accuracy denominator

s = propagated standard deviation of distance between survey points obtained from the least squares adjustment

d = distance between survey points

The distance accuracy pertains to all pairs of points (but in practice is computed for a sampling of pairs of points). The worst distance accuracy (smallest denominator) is taken as the provisional accuracy. If this is substantially different than the intended accuracy, then the provisional accuracy takes precedence. It is not feasible to precisely quantify "substantially different." Judgement and experience should be the determining factor.