

ASCE PROPOSED MODEL STANDARD of PRACTICE FOR PROPERTY BOUNDARY SURVEYS

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Abstract: This proposed standard is suggested as a model for adoption by local bodies of surveyors and engineers who practice land surveying. Besides expounding and clarifying certain often ignored surveying principles, it recognizes and accommodates the revolution in measurement technology that has occurred in recent decades. Rather than presenting a “method” specification for performing solely ground-based measurements, this proposed standard focuses on measurement results by employing the concept of position tolerance and incorporating statistical probability to assess measurement quality. This approach is useful for any measurement system, whether ground-, aerial-, or satellite-based.

ITEM 1. INTRODUCTION

To provide for stability of position and security of title through proper location and delineation of real-property boundaries, the American Society of Civil Engineers (ASCE) promulgates this proposed “Model Standard of Practice” for performing property boundary surveys for use by engineers and surveyors licensed to practice land surveying. This standard recognizes the continual change taking place in land-information systems and surveying technology, and it accommodates both classical and modern surveying methods, whether ground-, aerial-, or satellite-based.

ASCE recommends this standard for all surveys relating to creation, establishment, retracement, or resurvey of property boundaries (including easements), whether for public or private lands. This standard provides for public needs such as

1. Surveying, platting, and recording or filing documents to meet requirements of multipurpose cadastres, land-information systems, and statutes.
2. Properly describing newly created parcels, including easements.
3. Discovering and documenting gaps, overlaps, and encroachments for eventual resolution.
4. Setting new monuments to be readily locatable.
5. Surveying to prescribed accuracy for digital data bases for multipurpose cadastres, and for ready restoration of destroyed monuments.

This standard provides surveyors and recipients of surveys with guidance for surveying performance. Wherever this standard refers to a surveyor's duty, it is intended to include all persons who may actually perform tasks under the direction and supervision of the registered professional.

ITEM 2. DEFINITIONS

Surveyors should refer to *Definitions of Surveying and Associated Terms* (1978) by the American Congress on Surveying and Mapping and the American Society of Civil Engineers. This is an authoritative source of definitions for surveying and mapping terminology.

The following terms are inadequately treated or not included in *Definitions* (1978) and are here

defined:

Estimated uncertainty, Positional accuracy of a point, or accuracy of a measured or computed value, after all survey mistakes have been removed and systematic errors have been compensated. Uncertainty is due to the accumulation (propagation) of random error expressed as plus or minus the uncertainty value at a specific confidence level (e.g., 90%, 95%, etc.).

Position tolerance, The maximum allowable actual error in position of a point or new monument to be set. Expressed as the radius of a circle centered on the theoretical "true" position of a survey point. The "true" position is determined from controlling corners, and can never actually be established, because of measurement imprecision.

Controlling corner, A corner, the position of which controls the location of a subordinate corner in a hierarchical scheme. For example, four exterior 1/4 corners control the location of the center 1/4 corner of a section in the Rectangular System.

ITEM 3. GENERAL PROCEDURES

3.1 Scope

Surveyors should obtain sufficient information to understand the client's requirements and to define services. If more information is necessary, surveyors should advise clients that it must be obtained prior to determining the scope of services.

3.2 Acquire Ownership Evidence

1. Surveyors should acquire boundary information from abstracts, deeds, title reports and opinions, prior surveys, easements, and descriptions of neighboring properties. Abbreviated documents such as tax statements are usually inadequate evidence of real-property ownership. (See Item 4.1.)
2. Surveyors are expected to exercise reasonable care in record research, but are not required to examine and locate errors or omissions caused by defective title chains. They are not required to give title opinions.

3.3 Evaluate Capabilities

Even though legally qualified by registration, surveyors are still responsible for determining that their own abilities meet special needs of the project. Surveyors must possess proper knowledge, experience, equipment, and resources to undertake contemplated projects, and should determine that their capabilities are adequate.

3.4 Estimate Cost and Time

It is advisable to inform clients before work starts of estimated costs date when work could begin, and estimated time required.

3.5 Project Acceptance

1. Before beginning professional services for which payment is expected the surveyor and client shall reach agreement to fix the scope of the surveyor's duty, fee basis, and time period involved. For mutual protection, agreement shall be documented (e.g. memorandum, services letter confirmation of work ordered, or contract). The agreement can also establish extent of limitations of responsibility.
2. If previously unknown factors are discovered during work that will seriously affect either cost or completion schedule. the client should be informed at once.

ITEM 4. TECHNICAL PROCEDURES

4.1 Record Research

1. Under the legal doctrine of constructive notice, the surveyor is obliged to make reasonable searches for relevant records. Surveyors should search real-property records of public agencies to obtain survey history of subject and relevant adjoining properties. These records may include, but are not limited to, deed records, original government survey field notes and plats, subdivision plats and certificates of survey, deed exhibits, corner recordation forms, and court and county surveyor's records.
2. Other records may exist. Surveyors having actual notice of other records, whether public or private, must consider and obtain them if possible.

4.2 Analysis, Preliminary Conclusions, and Engineering the Survey Design

Surveyors should examine and analyze assembled data, formulate preliminary conclusions, then plan procedures and engineer the design of survey methods.

4.3 Field Investigation and Survey

Surveyors should

1. Search for, locate, and identify monuments and other physical evidence affecting record boundary location or lines of occupation.
2. Where relevant, consider extrinsic (e.g. parol) evidence of position of obliterated corners, and obtain affidavits.
3. Where relevant, locate and describe evidence of occupation.
4. Make necessary measurements, taking into account positional accuracy that must be achieved for the class of property being surveyed (Item 5).
5. Make sufficient check measurements to discover blunders and verify or validate other measurements.
6. Record all information and data collected in an appropriate, understandable form.

4.4 Computations and Conclusions

Surveyors should

1. Determine geometric relationships between control corners, evidence of occupation,

positions of lost and obliterated control monuments, and positions of corners to be established.

2. Apply proper theory of location for corners to be established or reestablished in accordance with law or precedent.
3. Evaluate all evidence obtained. Compare survey and record measurements. Resolve substantial disagreements between survey and record values.
4. In the event of substantial disagreement with another surveyor's measurements or monument positions, attempt to resolve by consultation.
5. Search for undiscovered control monuments or evidence at locations indicated by computations performed earlier.
6. If additional controls are found from this second search, connect to the survey and recompute positions of points that are dependent upon the recovered control.
7. Set sufficient monuments to comply with law and to enable field reproduction of the survey. (See Item 6.)
8. Document the results of the survey. (See Items 7 and 8.)

ITEM 5. POSITION STANDARDS

5.1 Classification of Properties

1. These standards recognize that higher-value lands require more accurate surveys. Accordingly, lands are arbitrarily divided into three major classes. (These classes may be further subdivided, depending upon local circumstances.)

Class A

City surveys: Urbanized and industrialized sections of cities. Land has comparatively very high value and requires surveys of high accuracy.

Class B

Urban and suburban surveys: Includes property in any densely settled or built up part of a town or city. Land used for residential or industrial subdivisions of comparatively moderate to high value. Rural property for which development is planned or probable in the near future, and for which value is increasing rapidly.

Class C

Suburban and rural surveys: Includes property such as rural home sites on large parcels, and agricultural, swamp, range, and forest land.

2. The classification of properties is a matter of collective judgment of local surveyors and other real-estate professionals, based on knowledge of local land use, value, custom, and other circumstances.
3. Standards are designed to provide stability of location of boundaries appropriate for property value and anticipated use. When anticipated use or value of a property is doubtful, prudent surveyors will choose more accurate standards.

5.2 Interpretation of Standards

1. The following standards are based on the concept of position tolerance of corners to be set. Tolerance is with respect to nearest adjacent controlling corners. Values are radii of allowable error circles, centered on the theoretical "true" point. Each class has an absolute maximum value, and Classes B and C contain variable limits dependent upon distance to controlling corners. (See Table 1.)
2. The standard quantifies acceptable actual position error (random and other) from all sources. It is not the standard for rejection or acceptance of other surveyors' corner positions. It could, however, be one criterion for judging acceptability of such corners.
3. After monuments are placed and documents filed or recorded, properly established new corners and properly reestablished lost corners have no actual error of position. These standards are to assure that such corners are placed to prescribed mensuration quality.

Values A, B, C, X, and Y are to be established by local regulatory bodies. In the absence of such regulations, local professional surveyor organizations may agree and publish such values. Values are to represent measurement results that can be achieved by blunder-free work with appropriate equipment and techniques, whether ground-~ aerial-, or satellite-based. (See Appendix I.)

Example: What position tolerance is required to place a 1/64 corner between section and 1/16th corners that control its location in the Rectangular System, with land values classified as urban (Class B)? Assume values for B = 0.0008, and X = 8 cm. For Class B surveys, with controlling corners 200 m distant (the approximate nominal distance to control in the Rectangular System), the position tolerance is computed as $[0.03 + (0.0008 \times 200)] = 0.190$ m; but since this exceeds the upper limit for this class the required tolerance is 8 cm.

For a situation with control only 50 m from the corner to be set, position tolerance is $[0.03 + (0.0008 \times 50)] = 0.070$ m. The estimated uncertainty of a new monument set should be less than the position tolerance, at a statistically high level of confidence (e.g. greater than 95%).

5.31 Positional Tolerance

Positional tolerance is not related to uncertainties due to differences between measured and record values or to uncertainties in the geodetic position of the point of beginning of a survey. Original corners (and new corners properly set and documented) have zero error of position.

TABLE 1. Position Tolerance

Property class (1)	Position tolerance at least (2)	But PT not greater than (m) (3)
A	A (meters)	A
B	3 cm + (B x s)	X
C	8 cm + (C x s)	Y

Note: s = distance to nearest controlling corner (m).

5.32 *Instruments*

Surveyors are to select instruments and engineer the design of operational procedures to give a statistically high probability (e.g. 95%, 98%) of attaining required accuracy. Surveyors should use error characteristics of instruments and procedures that have been determined by accepted statistical methods.

5.33 *Methodology*

Methodology should also include computational procedures for error propagation and error analysis that employ sound practice such as proper use of significant figures. Both rigorous and approximate methods of computing theoretical uncertainty due to error propagation are available.

ITEM 6. MONUMENTATION STANDARDS

6.1 Remonumentation of Original Survey Corners

Corner recordation acts in several states require surveyors to rehabilitate monuments. If remonumentation is required, usual standards stipulate substantial monuments with tablets large enough to identify the corner, surveyor, and date. Surveyors should also establish suitable accessories or reference monuments whenever physically practicable.

6.2 Property Corners

Refer to local monumentation standards for size, marking, and accessory requirements.

ITEM 7. GRAPHIC REPRESENTATION OF LAND SURVEYS

7.1 Plats and Certificates of Survey

1. Survey records are to be prepared on stable, durable media capable of reproduction, recording, digitizing, and permanent storage.
2. Conflicting monuments or property lines showing gaps or overlaps with adjoining properties will be clearly and understandably portrayed and clients informed of their existence.
3. Actual measured values (i.e. unadjusted for random error) should be shown on plats and certificates, to enable their future analysis. Values from the record shown for comparison should be shown in record units.
4. Surveyors should complete and file plats or certificates with proper local authority, in accordance with local regulations.

ITEM 8. CORNER RECORDATION

8.1 Filing Requirements

Surveyors should file recordation with proper local authority, for both newly set and rehabilitated or remonumented corners, in accordance with local regulations.

APPENDIX I. TYPICAL SURVEY STANDARD VALUES

Typical survey standard values are shown in Table 2. The typical values in Table 2 are consistent with results being obtained today with modern surveying instruments and techniques, including electronic distances and

TABLE 2. Typical Survey Standard Values

Properly class (1)	Position tolerance at least (2)	But PT not greater than (3)
A	18 mm	18 mm
B	$0.03 + (0.0008 \times s)$	8 cm
C	$0.08 + (0.001 \times s)$	20 cm

theodolites used in traverse, triangulation, or trilateration; by analytical photogrammetric methods using bundle adjustment; by inertial systems; and by use of satellites such as the Global Positioning System (GPS).

APPENDIX II. REFERENCE

Definitions of surveying and associated terms. (1978). ASCE, New York, N.Y.

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