National Spatial Data Infrastructure

Geospatial Positioning Accuracy Standards
Part 2:   Standards for Geodetic Networks

Federal Geodetic Control Subcommittee
Federal Geographic Data Committee

Federal Geographic Data Committee

Established by Office of Management and Budget Circular A-16, the Federal Geographic Data Committee (FGDC) promotes the coordinated development, use, sharing, and dissemination of geographic data.

The FGDC is composed of representatives from the Departments of Agriculture, Commerce, Defense, Energy, Housing and Urban Development, the Interior, State, and Transportation; the Environmental Protection Agency; the Federal Emergency Management Agency; the Library of Congress; the National Aeronautics and Space Administration; the National Archives and Records Administration; and the Tennessee Valley Authority. Additional Federal agencies participate on FGDC subcommittees and working groups. The Department of the Interior chairs the committee.

FGDC subcommittees work on issues related to data categories coordinated under the circular. Subcommittees establish and implement standards for data content, quality, and transfer; encourage the exchange of information and the transfer of data; and organize the collection of geographic data to reduce duplication of effort. Working groups are established for issues that transcend data categories.

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Federal Geographic Data Committee
Draft Geospatial Positioning Accuracy Standards
Part 2: Standards for Geodetic Networks

FGDC-STD-007.2-1998

CONTENTS

Page

2.1   Introduction

2.1.1   Objective

This document provides a common methodology for determining and reporting the accuracy of horizontal coordinate values and vertical coordinate values for geodetic control points represented by survey monuments, such as brass disks and rod marks. It provides a means to directly compare the accuracy of coordinate values obtained by one method (e.g., a classical line-of-sight traverse) with the accuracy of coordinate values obtained by another method (e.g., a Global Positioning System (GPS) geodetic network survey) for the same point.

2.1.2   Scope

Geodetic control surveys are usually performed to establish a basic control network (framework) from which supplemental surveying and mapping work, covered in other parts of this document, is performed. Geodetic network surveys are distinguished by use of redundant, interconnected, permanently monumented control points that comprise the framework for the National Spatial Reference System (NSRS) or are often incorporated into the NSRS.

These surveys must be performed to far more rigorous accuracy and quality assurance standards than those for control surveys for general engineering, construction, or topographic mapping purposes. Geodetic network surveys included in NSRS must be performed to meet automated data recording, submittal, project review, and least squares adjustment requirements established by the Federal Geodetic Control Subcommittee (FGCS).

2.1.3   Applicability

Geodetic network surveys are often employed when large geopolitical area (e.g., county-level or larger) mapping control is required, and where seamless connection with adjacent political areas is critical. Accurate network control may also be required for controlling interstate transportation corridors (highways, pipelines, railroads, etc.); long-span bridge construction alignment; geophysical studies; structural deformation monitoring of dams, buildings, and similar facilities.

2.1.4   Related Standards

Part 6: Point Profile, The Spatial Data Transfer Standard (FGDC, 1998) defines the format to be used to transfer geodetic coordinate data, including the accuracy of the coordinate values, between geographic information systems.

Part 3, National Standard for Spatial Data Accuracy (NSSDA), Geospatial Positioning Accuracy Standards (FGDC, 1998)provides the statistical and testing methodology for estimating the accuracy of point coordinate values produced from maps and other digital geospatial data with respect to geo-referenced ground positions of higher accuracy.

Federal Geographic Data Committee
Draft Geospatial Positioning Accuracy Standards
Part 2: Standards for Geodetic Networks

FGDC-STD-007.2-1998

The public review draft of Part 4, Standards for A/E/C and Facility Management, Geospatial Positioning Accuracy standards, uses the NSSDA for accuracy testing and verification. The NSSDA may be used for fully geo-referenced maps for A/E/C and Facility Management applicaitons such as preliminary site planning and reconnaissance mapping.

2.1.5   Standards Development Procedures

Draft accuracy standards for geodetic networks were developed by the FGCS Methodology Work Group, Federal Geographic Data Committee. The draft accuracy standards were released for public review through the FGCS and evolved into the final form presented in Table 2.1 of this publication.

2.1.6   Maintenance

The U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Geodetic Survey, maintains accuracy standards for geodetic networks for the Federal Geodetic Control Subcommittee, Federal Geographic Data Committee. Address questions concerning accuracy standards for geodetic networks to: Director, National Geodetic Survey, NOAA, N/NGS, 1315 East-West Highway, Silver Spring, Maryland 20910.

2.2   Testing Methodology And Reporting Requirements

2.2.1   Accuracy Standards

Note that the following accuracy standards supersede and replace the accuracy standards found in
FGCC 1984 and FGCC 1988 (see Section 2.3). The classification standard for geodetic networks
is based on accuracy. Accuracies are categorized separately according to Table 2.1 for
horizontal, ellipsoid height, and orthometric height. Note: although the largest entry in Table
2.1 is 10 meters, the accuracy standards can be expanded to larger numbers if needed.

Table 2.1 -- Accuracy Standards
Horizontal, Ellipsoid Height, and Orthometric Height

Accuracy Classification	95-Percent Confidence
	Less Than or Equal to:
1-Millimeter	0.001 meters
2-Millimeter	0.002 "
5-Millimeter	0.005 "
1-Centimeter	0.010 "
2-Centimeter	0.020 "
5-Centimeter	0.050 "
1-Decimeter	0.100 "
2-Decimeter	0.200 "
5-Decimeter	0.500 "
1-Meter	1.000 "
2-Meter	2.000 "
5-Meter	5.000 "
10-Meter	10.000 "

When control points in a survey are classified, they have been verified as being consistent with
all other points in the network, not merely those within that particular survey. It is not
observation closures within a survey which are used to classify control points, but the ability of
that survey to duplicate already established control values. This comparison takes into account
models of crustal motion, refraction, and any other systematic effects known to influence survey
measurements.

2.2.2   Accuracy Determination

The classification standard for NSRS is based on Table 2.1.

The procedure leading to classification involves four steps:

l.   The survey measurements, field records, sketches, and other documentation are
         examined to verify compliance with the specifications for the intended accuracy of the
         survey. This examination may lead to a modification of the intended accuracy.

2.   Results of a minimally constrained, least squares adjustment of the survey
         measurements are examined to ensure correct weighting of the observations and freedom
         from blunders.

3.   Local and network accuracy measures computed by random error propagation determine
         the provisional accuracy. In contrast to a constrained adjustment where coordinates are
         obtained by holding fixed the datum values of the existing network control, accuracy
         measures are computed by weighting datum values in accordance with the network
         accuracies of the existing network control.

4.   The survey accuracy is checked by comparing minimally constrained adjustment results
         against established control. The result must meet a 95 percent confidence level. This
         comparison takes into account the network accuracy of the existing control, as well as
         systematic effects such as crustal motion or datum distortion. If the comparison fails,
         then both the survey and network measurements must be scrutinized to determine the
         source of the problem.

Users with specialized applications that require more exacting accuracy estimates at the CORS
sites should contact NGS. It is not necessary to directly connect to a CORS to compute the
network accuracy of a control point. However, it is necessary that the survey be properly
connected to existing NSRS control points with established network accuracy values.

By supporting both local accuracy and network accuracy, the diverse requirements of NSRS users
can be met. Local accuracy is best adapted to check relations between nearby control points. For
example, a surveyor checking closure between two NSRS points is mostly interested in a local
accuracy measure. On the other hand, someone constructing a Geographic or Land Information
System (GIS/LIS) will often need some type of positional tolerance associated with a set of
coordinates. Network accuracy measures how well coordinates approach an ideal, error-free
datum.

Thus, for control points in the NSRS, both local accuracy and network accuracy will be reported
for each geodetic component (horizontal control, ellipsoidal height, and orthometric height).

2.2.3   Accuracy Reporting

When providing geodetic point coordinate data, a statement should be provided that the data
meets a particular accuracy standard for <u>both</u> the *local accuracy* and the *network accuracy*. For
example, these geodetic control data meet the 2-centimeter local accuracy standard for the
horizontal coordinate values and the 5-centimeter local accuracy standard for the vertical
coordinate values (heights) at the 95-percent confidence level. A similar statement should be
provided for these same data reporting the network accuracy.

Note: In the above statement the data may comply with one accuracy value for the horizontal
component and a different accuracy value for the vertical component. If a dataset does not
contain elevation data, label it for horizontal accuracy only; conversely, when a dataset does not
contain horizontal data, label it for vertical accuracy only.

It is preferred that accuracy value(s) be reported in metric units; however, feet shall be used when
the dataset coordinates are in feet (i.e., State Plane Coordinates in feet). The number of
significant digits for the accuracy value(s) shall be consistent with the number of significant
digits for the dataset point coordinates. For most geodetic control network applications,
centimeters should be used for reporting local accuracy and network accuracy values.

2.3   References

Federal Geodetic Control Committee, 1984, Standards and Specifications for Geodetic Control Networks: Silver Spring, Maryland, National Geodetic Survey, National Oceanic and Atmospheric Administration, 29 p.

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