DS-23045
(New)

DEVELOPMENTAL SPECIFICATIONS
FOR
GEOSPATIAL MAPPING OF SUB-SURFACE AND UNDERGROUND UTILITIES

Effective Date
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THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23045.01 DESCRIPTION.

The purpose of this specification is to capture as-constructed or as-built geospatial information for subsurface underground utilities including highway lighting and agency communication lines. Asset information shall be recorded and submitted as directed in this specification. It is the intent of the Contracting Authority to capture three dimensional (3D) as-built data within Contracting Authority right-of-way in accordance with the most current version of ASCE 75. As such, ASCE 75 shall serve as a guiding reference for this specification. The DOT has condensed its specific language into this specification for brevity. Clarifications or questions may be answered within Standard ASCE/UESI/CI 75-22. All tables are from *Standard Guideline for Recording and Exchanging Utility Infrastructure Data*, ASCE/UESI/CI 75-22, with permission from ASCE.

23045.02 MATERIALS.

GPS Equipment to record geospatial location to 0.1 foot and utilize project Geoid and Iowa Regional Coordinate system or transform to those coordinates. See https://iowadot.gov/iarcs/Home for coordinate system.

23045.03 CONSTRUCTION.

A. General.
During the building process or when there is exposure of subsurface utility infrastructure, measurements for both horizontal and vertical coordinates should be taken at every unique feature. This includes locations of horizontal and vertical shifts, deflection points, and at regular intervals across each unique feature to ensure the desired precision of position is achieved. The precision of the position shall be documented on a 0 to 5 scale.

B. Data Collection.
The roles pertaining to data compilation and verification include, but are not limited to, the subsequent points:

1. Document the location and Positional Precision of utility features as per the directives of Table 1-1.

2. Log utility characteristic data in alignment with Table 1-2.

3. Keep a record of the details related to the respective data gathering event.

4. Validate the data, meaning verify all data adheres to the set standard guidelines. The task of data verification can be allocated to the subcontractor in charge of the construction or installation of the utility feature, or the prime contractor overseeing the data gathering.

5. Quickly alert the utility proprietor about inconsistencies between pre-construction data and the actual installed utility locations that don't meet the Positional Accuracy criteria that are specified.

C. Trenchless Construction.

1. In situations where a linear feature's installation partially or entirely requires trenchless technology, the collection and documentation of utility location data should proceed as such:
   a. Apply survey methods to pinpoint the locations where the segment enters and exits the borehole, along with all necessary test pit verification points the boring intersects.
   b. Utilize indirect techniques, such as bore logs containing recorded inertial navigation data for the boring tip, or 3D electromagnetic sonde observations documented on the surface, between the borehole's entrance and exit. These data need to be obtained and recorded in 3D to attain Positional Accuracy as outlined by Table 23045.03-1. Given these data are acquired indirectly, Positional Accuracy Levels are undetermined.

2. If geophysical means yield poor results, there shall be sufficient metadata to clearly document that depictions are based neither on direct nor indirect measurements, but solely on judgment. For any portion of a trenchless feature not directly measured, the Positional Accuracy shall be reported as Indeterminate (Accuracy Level 0, see Table 23045.03-2).

D. Relative Location Positioning.

All relative spatial positions should be converted to absolute positions representing the X-Y-Z Centroid of the utility feature for mapping and data exchange purposes in line with ASCE 75-22.

E. Utilization of Positional Accuracy.

The Positional Accuracy of points gauged in the field should be evaluated separately from the Positional Accuracy of derived features. The Positional Accuracy Level of a measured point is frequently superior to that of a line segment between points.

F. Data Gathering Intervals.

During construction or when underground utility infrastructure is later exposed, the horizontal and vertical coordinate observations should be obtained at each unique feature, at horizontal turns, vertical turns, and deflection points, and along each unique feature with adequate interval frequency to reach the needed Positional Accuracy Level (Table 23045.03-1). The data structure of all deliverables should adhere to standardized field names, domain values, and depicted geometries, shown in Table 23045.03-2 through Table 23045.03-4, or allow direct mapping to the same fields per the Utility Data Schema excel file.

Table 23045.03-1. Levels of Positional Accuracy.

Accuracy Level	Accuracy (Customary Units)	Accuracy (SI Units)
Level 1	0.1 foot	25 millimeters
Level 2	0.2 feet	50 millimeters
Level 3	0.3 feet	100 millimeters
Level 4	1 foot	300 millimeters
Level 5	3 feet	1,000 millimeters
Level 0	Undefined	Undefined

Table 23045.03-2. Feature Types.

Attribute	Description	Example Domain Options
ID	Alphanumeric identifier of the feature	N-1
Owner	Entity owning the feature	IDOT, Any company
Operator	Entity or entities operating the feature	City of Ankeny
Utility Type	Type of service the feature provides	Communication, Electric, Non-potable water, etc.
Utility Subtype	Finer level of service type	Alarm, Alternating current (AC), Cable television, etc.
Feature Type	Category based on feature function and configuration	Segment, Device, Access point, etc.
Component	Subtype of a utility feature	Air eliminator, Amplifier, Anchor, etc.
Conveyance Function	Primary service purpose of the feature	Distribution, Gathering, Service, etc.
Intended Permanence	Intended longevity of the feature	Permanent, Temporary
Underground Status	Whether the feature is partially or completely underground	Aboveground, Underground, Submerged, Mixed
Operational Status	Operational status of the feature	Proposed, In service, Out of service, Abandoned, etc.
Horizontal/Vertical Spatial Reference	Coordinate system and datum for spatial reference	EPSG:7064 NAD83(2011) / IaRCS zone 8
Accuracy	Horizontal and vertical positional accuracies	measured in Feet or Millimeters
Feature Dimensions	Details about the size, position, and orientation of the feature	Dimensions, Azimuth, X-Y-Z coordinates
Linked File	File with additional information about the feature	
Date Data Collected	Date when the feature was surveyed	DD/MM/YYYY
Data Sensitivity Level	Sensitivity level of the recorded data	Unrestricted, Restricted, SSI
Certification	Whether the data has been certified, and by whom	TRUE, FALSE, Certification summary
Material	Main material of the feature	ABS, Aluminum, Asbestos cement, etc.
Protective Measures	Whether the feature has protection, encasement, or interstitial fill	TRUE, FALSE
Conveyance Method	How matter is conveyed through the feature	Gravity, Pressurized, High pressure, etc.
Cross Section Configuration	Cross-sectional shape of the feature	Arch, Box, Cable, etc.
Dimensions	Inside and outside dimensions of the feature	Heights, widths, lengths

Table 23045.03-3. Types of Geometry.

Type of Feature	Geometry Type (Minimum Required)	Geometry Type (Optional)
Segment	Line String	3D Object
Device	Point	Polygon or 3D Object
Access Point	Point	Polygon
Support Structure	Point	Polygon or 3D Object
Containing Structure	Polygon	3D Object
Secured Utility Zone	Polygon	-
Encasement	Line String	3D Object
Marker	Point	-
Tracer	Line String	

Table 23045.03-4. Feature Attributes.

Feature attribute	Segment	Device	Access point	Support structure	Containing structure	Secured utility area	Encasement	Marker	Tracer
ID	M	M	M	M	M	M	M	M	M
Owner	M	M	M	M	M	M	M	M	M
Operator	O	O	O	O	O	O	O	O	O
Utility type	M	M	M	M	M	M	M	M	M
Utility subtype	O	O	O	O	O	O	O	O	O
Feature type	M	M	M	M	M	M	M	M	M
Component	M	M	M	M	M	—	M	O	O
Delivery classification	M	M	—	M	M	—	M	O	O
Intended permanence	O	O	O	O	O	O	O	O	O
Underground status	O	O	O	O	O	O	O	O	O
Operational status	M	M	M	M	M	M	M	M	M
Horizontal spatial reference	M	M	M	M	M	M	M	M	M
Vertical spatial reference	M	M	M	M	M	M	M	M	M
Horizontal accuracy	M	M	M	M	M	M	M	M	M
Vertical accuracy	M	M	M	M	M	M	M	M	M
Accuracy units	C	C	C	C	C	C	C	C	C
X-*Y*-*Z* centroid	M	M	M	M	M	M	M	M	M
Azimuth	—	C	C	C	C	C	—	—	—
X-*Y*-*Z* observed	O	O	O	O	O	O	O	O	O
X-*Y* relative position	C	C	C	C	C	C	C	C	C
Z relative position	C	C	C	C	C	C	C	C	C
X-*Y*-*Z* junction point	O	O	O	O	O	O	O	O	O
Quality level	O	O	O	O	O	O	O	O	O
Linked file	O	O	O	O	O	O	O	O	O
Date data collected	O	O	O	O	O	O	O	O	O
Data sensitivity level	O	O	O	O	O	O	O	O	O

Is certified	O	O	O	O	O	O	O	O	O
Certification summary	O	O	O	O	O	O	O	O	O
Material	O	—	—	O	—	—	O	—	O
Is cathodic protected	O	—	—	O	—	—	O	—	O
Is encased	O	—	—	—	—	—	—	—	O
Is filled	O	—	—	—	O	—	O	—	—
Interstitial fill material	O	—	—	—	O	—	O	—	—
Conveyance method	O	O	—	—	—	—	—	—	—
Cross section configuration	O	—	—	—	—	—	—	—	—
Number of conduits	O	—	—	—	—	—	—	—	—
Inside height	O	—	—	—	O	—	O	—	—
Inside width	O	—	—	—	O	—	O	—	—
Inside length		—	—	—	O	—	—	—	—
Outside height	O	O	—	O	O	—	O	—	—
Outside width	O	O	O	O	O	O	O	—	—
Outside length		O	O	O	O	O	—	—	—
Wall thickness	O	—	—	—	O	—	O	—	—
Measurement units	C	C	C	C	C	C	C	—	—
Note: M = minimum requirement; O = optional; C = conditional (becomes a minimum requirement if the geometry type used is a 3D object or if observed data are available); and — = does not apply.									

G. Data Validation And Responsibilities

This function comprise of, but are not restricted to, the following elements:

1. Validate the accuracy of the collected data as conforming to this standard guideline. The party in charge of the utility feature installation or the party overseeing the data collection shall designate the qualified individual who validates the data's accuracy.

2. Validate that the data included in a deliverable meets Positional Accuracy requirements.

3. Validate that the data included in a deliverable incorporates the necessary data elements as outlined in Table 23045.03-1. The validated data may also include optional data elements agreed upon among stakeholders, including the party responsible for constructing the utility infrastructure, the party responsible for the data collection, the Contracting Authority, and the utility owner. Competency requirements to fulfill these responsibilities effectively include, but are not limited to, the following:

- **a.** Basic understanding of equipment and methods employed in surveying and locating.
- **b.** Knowledge of coordinate systems, projections, and project datum.
- **c.** Comprehension of data attribution as recommended by this standard guideline and/or required by the Contracting Authority.
- **d.** Familiarity with systems and software necessary to produce deliverables required by the Contracting Authority.
- **e.** Awareness of the requirements and goals of standard ASCE/UESI/CI 75-22 guideline and ASCE 38; and
- **f.** Certification as a Professional Engineer, authorized land surveyor, or under the supervision of either.

H. Deliverables.

1. The data structure of all deliverables shall adhere to standardized field names, domain values, and depicted geometries, as shown in the Utility Layers Schema or enable direct

mapping to the same. Geospatial shapefile (.SHP) with all corresponding files including the .PRJ file with coordinate information assigned, submitted to DOT-utilitydata@iowadot.us. A geodatabase template file may also be requested from DOT-utilitydata@iowadot.us.

2. ESRI Shapefiles or geodatabase are preferred, but alternative filetypes that are acceptable are: 2D and 3D Computer-Aided Design (CAD) files or design (DGN) refer to Chapter 40B-1 of the design manual Feature Codes – Full Descriptions (iowadot.gov), Comma-Separated Value (CSV) files, Building Information Modeling (BIM) files, Extensible Markup Language (XML) files, JavaScript Object Notation (JSON) files, Geographic Information System (GIS) files, Graphic Markup Language (GML) Files, Relational Database Records, Spreadsheet files, and Web Feature Services (WFS).

23045.04 METHOD OF MEASUREMENT.

Geospatial Mapping of Sub-Surface and Underground Utilities will be measured per linear foot of completed mapping shapefile of all underground utilities, including measuring the perimeter of polygons.

23045.05 BASIS OF PAYMENT.

A. Linear Feet

B. Payment is full compensation for geospatial shapefile (.SHP) with all corresponding files including the .PRJ file with coordinate information assigned, submitted to DOT-utilitydata@iowadot.us. The Engineer shall verify this has been submitted, free of errors, prior to payment.