SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

# SURFACE VEHICLE STANDARD

SAE J1663

ISSUED AUG95

Issued 1995-08

Submitted for recognition as an American National Standard

## TRUTH-IN-LABELING STANDARD FOR NAVIGATION MAP DATABASES

***Foreword***—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

This SAE Standard defines consistent terminology, metrics, and tests for describing the content and quality of navigable map databases. This standard will allow users to determine whether a given map database meets the needs for their application. (A truth-in-labeling standard does NOT specify the physical format of the database or minimum performance standards.)

The focus of this document is to support the navigation applications that automotive manufacturers and suppliers are currently developing for marketplace delivery. While the focus is on in-vehicle navigation applications for motor vehicles, the document will be applicable to other ITS traveler applications using digital maps. The primary audience for this document is systems developers of passenger vehicle navigation products.

### TABLE OF CONTENTS

1. Scope ........ 2
2. References ........ 2
2.1 Applicable Publications ........ 2
3. Definitions ........ 3
4. Commercial Disclosure Statement ........ 3
5. Structure of this Document ........ 3
5.1 Name and Definition ........ 3
5.2 Metrics ........ 4
5.3 Testing Mechanism ........ 4
6. Coverage ........ 4
6.1 Geopolitical Areas ........ 4
7. Currentness ........ 4
8. Applications ........ 5
9. Nodes and Junctions ........ 5
9.1 Definition ........ 5
9.2 Types of Nodes and Junctions ........ 5
10. Location and Existence of Attached Links ........ 7
10.1 Link ........ 7
11. Road Names ........ 7
11.1 Highway Names ........ 7
11.2 Highway Alias Name ........ 7





**QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243**
**TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790**
**http:\\www.sae.org**



Printed in U.S.A.

11.3 Street Name ... 7
11.4 Street Alias Name ... 7
12. Address Range ... 7
12.1 Address Components ... 7
12.2 Address Range Systems ... 8
12.3 ZIP Codes ... 8
13. Road Classifications ... 8
13.1 Types of Roadway Classifications ... 8
14. Restricted Maneuvers ... 9
14.1 Restricted Maneuver ... 9
14.2 Categories of Restricted Maneuvers ... 9
15. Metrics ... 9
15.1 General Metrics for Variables and Attributes ... 9
15.2 Metrics for Nodes and Junctions ... 10
15.3 Metrics for Attached Links ... 11
15.4 Metrics for Limited Access Road Names ... 12
15.5 Metrics for Unaddressed Non-Limited Access Roads ... 12
15.6 Metrics for Addresses—General ... 12
15.7 Metrics for City-Type Addresses ... 12
15.8 Metrics for Irregular (Vanity) Addresses ... 12
15.9 Metrics for Landmark Addresses ... 12
15.10 Functional Road Classification Metrics ... 12
15.11 Physical Road Classification Metrics ... 14
15.12 Physical Characteristics Road Classification Metrics ... 15
15.13 Special Routing Road Classification Metrics ... 16
15.14 Metrics for Restricted Maneuvers ... 17
16. Testing Procedures ... 17
16.1 Test Methods—General ... 17
16.2 Test for Network Completeness and Accuracy ... 19
16.3 Test for Nodes and Junctions ... 19
16.4 Test for Attached Links ... 19
16.5 Test for Completeness and Accuracy of Road Name and Road Classification ... 19
16.6 Test for Address Range ... 19
16.7 Test for Turn Restrictions ... 20




***1. Scope—***This SAE Standard is a truth-in-labeling standard for map databases.

***2. References***

**2.1 Applicable Publications—**The following publications form a part of the specification to the extent specified herein.

2.1.1 ANSI/ASQC Publication—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI/ASQC Z1.4 1981—ANSI Standard for Quality Testing

2.1.2 North American Datum Publications—Available from U.S. Geological Survey, Box 25046, Building 810, Denver Federal Center, MS 504, Denver, CO 08225-0046.

North American Datum 1927—National Geodetic Survey
North American Datum 1983—National Geodetic Survey

2.1.3 WORLD GEODETIC SYSTEM DOCUMENT—Available from U.S. Geological Survey, Box 25046, Building 810, Denver Federal Center, MS 504, Denver, CO 08225-0046.

World Geodetic System 1984—An internationally standardized coordinate system

## *3. Definitions*

**3.1 Motor Vehicle—**In this version of the document, the term motor vehicle is restricted to include only privately owned vehicles designed primarily for use on U.S. roads. It includes cars, light trucks, vans, and sport utility vehicles that are not towing anything that would restrict the use of the vehicle.

**3.2 Digital Map Database—**A two-dimensional complex in which geographic and roadway network features are projected onto an ellipsoid. For this document, the database supplier must state the coordinate system used. The supplier must state the original coordinate system used when taking measurements and the method of translating from the original coordinate system to the coordinate system used. For example: "Nodes were measured in NAD 27 and converted to NAD 83 by algorithm A." The algorithm must be provided.

***4. Commercial Disclosure Statement—***All databases offered under this standard will contain the following Commercial Disclosure Statement:

"This map database is intended to support in-vehicle navigation applications. The information contained in the database is not intended to replace or supersede human judgment or reason, and should be considered only as an informational aid in decision making.

This map database is accompanied by a vendor-supplied statement of accuracy, completeness, and currentness of key components of the database in conformance with SAE J1663. This vendor statement was validated and certified by a testing institute of the Society of Automotive Engineers (SAE).

This certification does not guarantee that the map database is accurate in all respects, but simply that the vendor's claims for database accuracy, completeness, and currentness are accurate at a ____ %[1] confidence level as of the date specified under currentness. The user should be aware that changes may have occurred to the street and roadway system, or to other real-world entities covered in the map database, since the map database certification was performed."

***5. Structure of this Document—***The document consists of definitions and detailed descriptions of the map database attributes to be included by the vendor in its statement, followed by metrics and tests for each kind of object or characteristic.

Digital map databases contain information on nodes, links, regions, and points of interest (collectively: "objects"). For each such object and characteristic, the document will include:

a. Name and Definition
b. Metrics
c. Test

**5.1 Name and Definition—**Definitions attempt to precisely and unambiguously describe the entity in question. To the extent possible, the names were chosen to evoke the industry's (and the public's) intuitive understanding of the concept.

1. This percentage will be established by the Testing Institute.

**5.2 Metrics**—A metric is a scale against which an object or characteristic is evaluated. Multiple metrics may apply to an object or characteristic, since:

a. Different applications may require different metrics
b. A particular application may require more than one metric (e.g., quality of an individual instance plus percentage of instances in a database which are of this quality)

For each object or characteristic, one or more base metrics are defined.

**5.3 Testing Mechanism**—A testing mechanism is used to score an object or characteristic against an applicable metric. Tests are designed to be:

a. Feasible (practical with respect to procedure and cost)
b. Replicable
c. Independent of the data sources used to build a database, whenever feasible

***6. Coverage***—Coverage will be specified for each attribute. Vendors shall state coverage for a particular map database in the U.S. as a collection of county/state pairs, and in Canada as a collection of census division/province pairs. If some additional portion of a county is included in the coverage, the criteria for such inclusion and the geographic description of the included part shall be stated clearly.

**6.1 Geopolitical Areas**

6.1.1 STATES—States are the major political divisions of the United States. Additionally, there are "state equivalents" such as the District of Columbia and the outlying possessions of Guam and American Samoa, the Commonwealth of Puerto Rico, and the Territory of the U.S. Virgin Islands. Provinces are the major political divisions of Canada.

6.1.2 COUNTIES—Counties are the basic political divisions of the states. Their boundaries are defined by their respective state governments. All states have counties with the exception of Alaska where the Census Bureau created county equivalents called "Census Areas" and "Boroughs." In Louisiana, counties are called "parishes." There are county equivalents called "Independent Cities" which are cities politically independent of any county. Baltimore, MD; St. Louis, MO; and Carson City, NV are independent cities as are 41 cities in Virginia.

In Canada, Census Division is the generic term for the basic political divisions of the provinces except for Newfoundland, Manitoba, Saskatchewan, and Alberta, where it applies to equivalent statistical areas created by Statistics Canada. Where the Census Divisions are political entities, their names vary from province to province. They are called counties in Prince Edward Island, Nova Scotia, and parts of Ontario. In the rest of the provinces they may be called regional districts, regional municipalities, and at least 5 other names. The lack of consistency for this type of area may make it difficult, if not impossible to select Census Divisions as a measurement area for many parts of Canada.

***7. Currentness***—Currentness of any database attribute shall refer to the most recent date on which the database supplier has determined the attribute is accurate to a specified level.

Any database will have a number of currentness dates in month/year format corresponding to various attributes.

The suppliers' Statement of Currentness shall have a format similar to the example in Figure 1:

Database: Named Coverage Area (coverage area as defined by the vendor)

Road geometry meets stated accuracy and completeness as of January, 1993
Turn restrictions meet stated accuracy and completeness as of December, 1992

.
.
.

Highway Names meet stated accuracy and completeness as of October, 1992

FIGURE 1—EXAMPLE OF SUPPLIERS' STATEMENT OF CURRENTNESS FORMAT



***8. Applications***—This document focuses on attributes needed for motor vehicle navigation applications:

a. Address Location—Translating a user-oriented place specification (e.g., street address, intersection, vanity address, named place) to a specific object such as a node or link in the database
b. Route Determination—Calculating a legal driving route between two specified places
c. Route Guidance—Delivering real-time driving directions to the driver, based on a determined route and vehicle position/speed
d. Vehicle Positioning—Determining where the vehicle is in relation to map elements (e.g., via Map Matching, GPS)
e. Display—Visually presenting information from the database to the user

## *9. Nodes and Junctions*

**9.1 Definition—**A node (0-cell) is a topologically significant point, such as a simple intersection of roadways or other linear features, or an endpoint of such a feature. A junction is a collection of more than one node that represents a logical feature, such as a complex intersection.

Node location is based on position as defined by centerline data.

a. The centerline of a roadway is the center of the predominant width of the physical pavement (or other surface), ignoring such local aberrations as turn-lane cutouts, shoulders, etc.
b. For roads with center medians, vendors will state their criteria for representing single or multiple center lines and nodes.
c. The endpoint of a road is where its centerline ends (either in a "dead end" or by intersecting in a "T" shape with another centerline roadway).

### 9.2 Types of Nodes and Junctions

9.2.1 ROADWAY NODES AND JUNCTIONS—Result from the intersection of roadways.

a. An intersection is the meeting point of the centerlines of the intersecting roadways.

1. A simple intersection is an intersection (without offsets) of two roadways (without center medians), which can be represented by one node (see Figure 2).

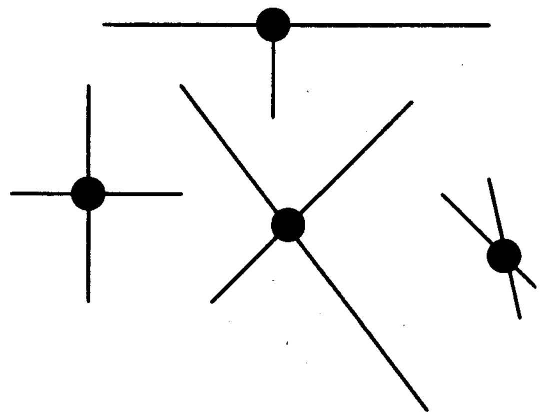

FIGURE 2—SOME SIMPLE INTERSECTIONS

2. A complex intersection is any intersection that is not simple. Some examples of complex intersections are the intersection of roadways involving offsets, central medians or some combination of offsets and central medians which can generate multiple nodes depending on the representation used by the vendor. (See Figure 3.) The vendor shall state its policy for identifying and classifying complex intersections.

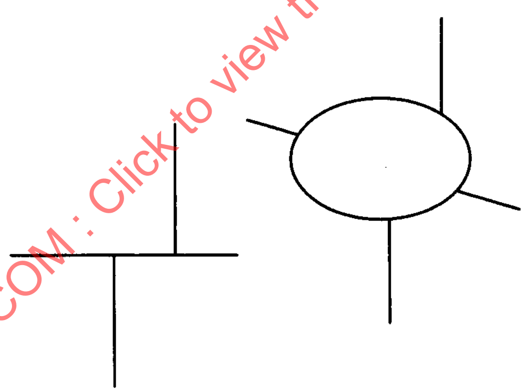

FIGURE 3—SOME COMPLEX INTERSECTIONS



9.2.2 ROADWAY ENDPOINT NODE—The endpoint of a roadway centerline.

9.2.3 MISCELLANEOUS NODES AND JUNCTIONS—Result from the intersection of roadway and non-roadway features (hydrography, railroads, political boundaries, etc.). Intersections of roads with non-road features such as political units, physical features, and water features will not be tested. Nodes and junctions representing the intersection of roadway and non-roadway features are not critical to the applications for which this document is intended.

***10. Location and Existence of Attached Links***

**10.1 Link—**A link (1-cell) is a topological connection between two nodes. A link may contain additional intermediate coordinates called "shape points" to better represent the shape of curved features.

Crucial characteristics of a roadway link include its name(s), address range, roadway classification, geometry/shape and length.

***11. Road Names—***The text that identifies a road on roadside signs, road maps, and documents.

**11.1 Highway Names—**The text that identifies a highway on roadside signs, road maps, and documents. It consists of the highway type or icon, e.g., Interstate, U.S., State, County Route, etc., route number (can be alphanumeric), and an optional modifier. A modifier is text following or preceding the number.

For example, I-80 Business Route has the modifier "Bus. Rt." (Other examples are "Alternate," "Truck Route," etc.)

**11.2 Highway Alias Name—**A commonly used or officially designated name for a highway that is not a highway name as defined previously.

Examples: in Chicago I-290 is also called the Eisenhower Expressway, and portions of U.S. 41 are called Lake Shore Drive. I-880 in Alameda County is also called the Nimitz Freeway.

**11.3 Street Name—**The officially designated name for a road that is not a highway.

**11.4 Street Alias Name—**A commonly used or official alternate name for a street.

***12. Address Range—***The range of house (structure) alphanumeric sequence (typically numbers) associated with a particular name of a link. Address ranges will be specified by alphanumerical range (by block) and side of the street. A complete address includes the correct name of the link, including prefixes and suffixes, the address range for a particular block, and the zip code.

**12.1 Address Components—**Urban addresses consist of three components which constitute the minimum for locating structures.

The first component is the primary address number, which is part of the block Address Range (see 12.2).

The second component is the street name body. Street name bodies can be further broken down into four components:

a. Predirectional which would appear as N, E, W, S, NE, NW, SE, or SW
b. Street Name, e.g., "Pennsylvania"
c. Street Suffixes, usually abbreviated, e.g., "Ave."
d. Postdirectional, e.g., "N.W.". Postdirectionals should also include all the predirectionals plus "EX" for extended streets

Some local address systems do not use predirectionals, street suffixes, and/or postdirectionals. Only the street name is a mandatory requirement in all areas. However, if predirectionals, suffixes, and/or postdirectionals are used in the coverage area or part of the coverage area, the vendor must have the complete name to be counted as correct.

The third component is the ZIP Code (See section 12.3). The "+4" portion of a Zip Code is not necessary for locating addresses with an in-vehicle navigation system although future systems might make use of it.

**12.2 Address Range Systems—**In many cases, address ranges vary according to the side of the street. Some addresses are arbitrary points, or out of range. Irregular addresses include vanity addresses and points of interest such as airports and parks. The basic systems for address numbers are:

a. Baseline Hundred Range System—Street numbers begin at a "baseline" intersection, and each block is assigned a series of a hundred numbers. Parallel streets are usually in the same hundred range.
b. Non-baseline Hundred Range System—In this system, no baseline exists. Therefore, hundred ranges start at the beginning of a given street and continue to its end. Therefore, corresponding blocks of parallel streets may not be in the same hundred range.
c. Non-Hundred-Range System—Street numbering continues sequentially with some gaps without respect to intersections.
d. It is rare that all the possible addresses in a particular range are actually used. For example, the 300 block of Main Street may actually include only numbers between 300 and 327, rather than between 300 and 399. The vendor must specify whether he is using actual or logical address ranges.

**12.3 ZIP Codes—**ZIP Codes are 5-digit codes defined by the U.S. Postal Service that identify specific geographic delivery areas. ZIP Codes can represent an area within a state, or an area that crosses state boundaries (an unusual condition). They can represent a single building, company, or organization which has a very high mail volume. A ZIP Code can also represent a "post office box only" post office. ZIP Codes also have a "+ 4" add-on consisting of a "ZIP sector" and "ZIP Segment." The + 4 sectors and segments are extremely difficult to delineate. The document will consider only "Zip Classification Code = [blank]" 5-digit ZIP Codes: those that roughly represent a geographic area rather than a single building or company. (Formerly called "type 80" records.)

Postal Codes in Canada are 6-character alphanumeric codes that identify the "Forward Sortation Area" (first three characters) and the "Local Delivery Unit" (second three characters) of Canada Post delivery areas. Postal Codes are similar to 5-digit ZIP Codes.

## *13. Road Classifications*

**13.1 Types of Roadway Classifications—**Roadway Classifications group and distinguish links according to physical or logical characteristics. Classification schemes are:

a. Physical—A physical classification of a roadway is based solely on its physical attributes and the determination of the classification is independent of any other road or road segment. Sample physical roadway classifications include highway with fully controlled access, highway with partially controlled access, arterial street, local or residential road, frontage road, ramp, turning roadway, and low mobility roadway. Vendors shall state whether roads are grouped by physical classification, functional classification, or a combination, and provide a brief description of the levels.
b. Functional—A functional classification of a roadway segment within a logical network is based on its use in determining the most efficient travel movement and, therefore, must be classified in conjunction with adjacent segments. Sample functional roadway classifications include principal artery, minor artery, local artery, connector artery, and non-artery. Vendors shall state whether roads are grouped by physical classification, functional classification, or a combination, and provide a brief description of the levels.
c. Official or Special Routing—Official or special routing classifications are used to designate scenic routes, bus routes, business routes, and truck routes. Vendors shall state whether official or special routing classifications are used, and provide a brief description of the classificatons provided.

## *14. Restricted Maneuvers*

**14.1 Restricted Maneuver—**A restricted maneuver is a prohibition of movement from one roadway (link) to another roadway (link) due to a physical impedance, regional restriction, one-way flow of traffic, or a posted restriction. Multiple restrictions may pertain to any link and these restrictions may be limited to a specific time of day and/or day of the week.

**14.2 Categories of Restricted Maneuvers**

14.2.1 REGIONAL RESTRICTIONS—There are some differences in the rules of the road between states; for instance, in California U-turns may be made only at an intersection, but in Illinois and Michigan U-turns are not allowed at intersections. Regional restrictions differ by state and sometimes by city. Regional restrictions include turn restrictions, U-turn restrictions, and unposted speed limits. Regional restrictions are usually default restrictions.

14.2.2 IMPLIED TURN RESTRICTIONS—Some restrictions are not explicitly posted, but can be derived from other restrictions. An example is a left turn that is prohibited because it would result in going the wrong way on a one-way street.

14.2.3 EXPLICIT TURN RESTRICTIONS—Explicit turn restrictions are those not implied by other attributes such as one-way streets, barriers, or overpasses. All explicit restrictions are posted. Each restriction is a separate item for determining completeness of the database. Simple explicit turn restrictions involve only one 0-cell (node). Complex turn restrictions involve multiple 0-cells.

14.2.4 BARRIERS—Barriers may be divided into three categories: Physical barriers, which prohibit movement for normal passenger vehicles; Legal Administrative barriers, which legally prohibit movement; and Physical Administrative barriers, such as security gates, which prohibit movement by unauthorized vehicles. Barriers are significant only to the extent that they restrict driving maneuvers; restricted maneuvers (one-way, no left turn, etc.) caused by barriers are included in the numbers for implied restrictions.

## *15. Metrics*

**15.1 General Metrics for Variables and Attributes—**The current specification for the Map Database Testing Institute describes two categories of vendor claims that can be tested against this standard, and describes the basic structure of the appropriate metrics and testing procedures to be used for these categories of vendor claims. Attributes are vendor claims where the map database object is either there or it isn't, while variables are vendor claims where the claim involves geographic accuracy of the object. All map database objects may be classified as either attributes or variables, and tested accordingly.

The approach being followed is to define components, reference sources, and metrics to provide a standardized method of description of data quality. However, there are no minimum thresholds which tested components must exceed; instead, the emphasis is on communicating accurate and objective information on validating vendor claims as a means of assisting the user in the process of assessing the fitness of a data set for a specific application.

Two general approaches are to be used, depending on the nature of the component being assessed.

Some components are simple statements of fact that can be either true or false (attributes). In these cases, the required metrics are simple percentages, to be interpreted as probabilities that an item of information in the database is in error. For example, the quality of the road names might be 0.3%, meaning that the Testing Institute has estimated that 99.7% of the road names in the database are correct based on the vendor claim and the sample tested, and 0.3% are incorrect, or that the name attached to a particular road segment has a 0.997 probability of being correct and a 0.003 probability of being in error.

In some cases where components are simple statements of fact, it is important to estimate errors of omission and commission separately. False negatives, or errors of omission, occur when a real feature is missing from the database. False positives, or errors of commission, occur when a feature in the database is not present in reality.

In other cases, the component error must be measured as the difference between a component in the database and ground truth (variables). For example, error in position can be expressed as a measure of the difference between the position recorded in the database and the true position. In these cases, the required metric is a standard error (SE) or root mean square error (RMSE), defined as the square root of the mean of the squared differences between recorded value and true value.

**15.2 Metrics for Nodes and Junctions—**Each map database attribute or object described in the first half of this document has a corresponding metric.

15.2.1 ROADWAY WITH ROADWAY

*15.2.1.1 Simple Intersection*

a. The metric is a comparison of the coordinates of the intersection as represented in the database with the real world coordinates of the same intersection. Comparing the coordinates to reality involves the following subtasks:

   1. Errors in the position of the intersections will be reported in hierarchical format:

      N % errors in position within X distance.
      M % errors in position within Y distance, where Y is greater than X.

   2. Results of the metrics above will be expressed as a percent, i.e., Z% of nodes tested were within X distance of location in reality.

b. Spurious nodes will be detected with the following metric: How many nodes represented in the database do not exist in reality? (The spurious node metric can be tested only in association with simple intersections. Method-induced nodes for complex intersections will occur as function of technique and must be disassociated from actual error. Method-induced nodes used to designate attribute changes should also be disassociated from actual error.)
   Simple intersection metrics will be reported by class of road or roads that intersect. For example, see Figure 4.

| | Street | Arterial | Highway | Etc. |
|---|---|---|---|---|
| Street | | | | |
| Arterial | | | | |
| Highway | | | | |
| Etc. | | | | |

FIGURE 4—EXAMPLE OF SIMPLE INTERSECTION METRICS

c. Missing nodes will be detected with the following metric: How many nodes that exist in reality do not exist in the database?

15.2.1.2 *Complex Intersections*—The procedural methods used to represent complex intersections will generate various numbers and positions for nodes depending on the philosophy of the system designers relating to the function of the representation. As a consequence, varying representations of complex intersections are to be expected.

For that reason, the appropriate metric is to test the vendor's procedure for digitizing complex intersections against the representation as it appears in the database. The vendors must state their procedure for representing complex intersections. The metric is the accuracy of the database to ground truth, under the vendor's stated representation.

The report will be qualified by type of intersection. The metric is a percentage that represents the relationship of intersections correctly represented to the sample tested.

Complex intersection metrics will be reported by class of road or roads that intersect. For example, see Figure 5.

| | Street | Arterial | Highway | Etc. |
|---|---|---|---|---|
| Street | | | | |
| Arterial | | | | |
| Highway | | | | |
| Etc. | | | | |

FIGURE 5—EXAMPLE OF COMPLEX INTERSECTION METRICS

15.2.2 ROADWAY ENDPOINT

a. Completeness Metric—Of all roadway endpoints that exist in the mapped coverage, what percentage are coded as endpoints in the database?
b. Accuracy Metric—Of all the endpoints that exist in the database, what percentage exist in reality? (Endpoints introduced into links at the edge of a database extract should not be treated as errors.)
c. Positional Metric—The percentage of endpoints that are accurate within X meters of the road's endpoint in reality (reported hierarchically).

15.2.3 REFERENCE POINTS—The database supplier will state the number of actually measured reference points as a percentage of the total number of nodes in the system. The database supplier will also state the source of the reference points. For example: "25 reference points were measured with a differential GPS receiver in WGS 84 coordinate system."

**15.3 Metrics for Attached Links**

a. Links must be tested as follows in Figure 6:

| | Link Exists in Database | Link Absent in Database |
|---|---|---|
| Link Exists in Reality | type 1= no error | type 2 (error) |
| Link Absent in Reality | type 3 (error) | |

FIGURE 6—MATRIX EXAMPLE—LINKS

Type 2 and type 3 are errors. Reporting these errors should be on a percentage basis classified both by road type and the nature of the error (omission versus commission).

b. Accuracy of Shape/Geometry—Shape will be handled differently by different vendors. The procedure is to have vendors report their rules for representing shape and then test how well they perform this self-defined task, using the tolerance radius method discussed in the testing section. The report should be classified by road type. The metric is the accuracy of representation versus ground truth under vendor's representation.

c. Length—Length may either be calculated from the position of the boundary nodes, attached as an attribute to the link, or calculated by traversing the link from node to node through all included shape points. The procedure is to have vendors report the method used to calculate distance and then test how well they performed this self-defined task. The report should be classified by road type.

**15.4 Metrics for Limited Access Road Names—**Because of the great importance of limited access roads to map database applications, a separate metric for name completeness and accuracy is defined. The unit of measurement is called a "segment." A segment is a portion of a limited access road between two interchanges. The coverage area for the test is a county. The ground-truth surrogate should be state DOT maps. If a vendor claims better accuracy than state DOT maps, claims will be measured against ground truth. Vendors may dispute apparent database discrepancies by demonstrating the correspondance of their database against ground truth. The result of the test should be the percentage of segments in the county correctly named. Alternate names will not be tested.

**15.5 Metrics for Unaddressed Non-Limited Access Roads—**There are many areas, especially but not exclusively rural, where roads have names but are not addressed. The unit of measurement for these roads is a "segment," which is defined as a portion of a non-limited access road between two intersections or between an intersection and the beginning or ending of a road. The coverage area for this test is county. The ground-truth surrogate is state DOT maps, if the maps meet the necessary accuracy requirements. The result of this test should yield the percentage of segments correctly named in a given county.

**15.6 Metrics for Addresses—General**

a. Completeness Metric—Of all addresses that exist in the mapped coverage, what percentage are coded correctly in the database?

b. Accuracy Metric—Of all the addresses that exist in the database, what percentage exist in reality? What percentage are on the correct link?

**15.7 Metrics for City-Type Addresses—**The metric is the percentage of psuedo-records created from ZIP+4 Type 10 records that are captured in the database, and the percentage that are on the correct segment and side of the segment. If the vendor claims accuracy greater than ZIP+4, then the metric is ground truth.

**15.8 Metrics for Irregular (Vanity) Addresses—**Similar to the metrics for city-type addresses, except use ZIP+4 Type 20 records for creating pseudo-records. If the vendor claims accuracy greater than ZIP+4, then the metric is ground truth.

**15.9 Metrics for Landmark Addresses—**Since selecting landmark addresses is highly subjective, no completeness metric is defined. The accuracy metric is percentage of database landmark addresses that appear appropriately in the real world.

**15.10 Functional Road Classification Metrics—**Vendors Shall:

a. State number of Functionally Distinct Levels in database (FDLs)
b. Describe the methodology used to separate the network into Functionally Distinct Levels. If a standard set of classifications is used, such as AASHTO or FHWA, that standard should be specified and the appropriate documentation made available for review upon request.
c. Define the distinct levels.
d. Describe how the FDLs in the network are connected. Examples include:
   1. Topologically upwards, where the highest level is contiguous and each subsequent level, although they may not be individually contiguous, form a complete connected network when they are incrementally included.
   2. Topologically disconnected, where the individual levels when incrementally combined do not form a contiguous network.
e. State the connectivity for each level in the network. Provide a detailed breakdown indicating whether the level is contiguous with the one above it and if it is not, the percentage of that level that is disconnected.
f. State the proportion of links in the database that are labeled by the vendor to indicate one-way only travel.
g. State the proportion of navigable segments in the database that are labeled as one way in relation to the total number of navigable segments in the database.
h. State proportion of entire database in each FDL (by percentage of number of links).

15.10.1 CURRENTNESS MATRIX—State the currentness date for each level in month/year format. (See Figure 7).



Functionally Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 6/7/93 | 6/93 | 4/92 | 4/92 | MM/YY |

Current as of ...

FIGURE 7—FUNCTIONAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—CURRENTNESS

15.10.2 COMPLETENESS METRIC—Number of links by FDL included in the database in proportion to the total number of links by FDL for the area coverage defined for that PDL (physically distinct level). (See Figure 8.)

Functionally Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 99 | 98 | 97 | 75 | 65 |

Percentage of Completeness

FIGURE 8—FUNCTIONAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—COMPLETENESS

15.10.3 ACCURACY—Number of links by FDL, included in the database that are correctly classified in proportion to the total number of links by FDL for the area of coverage defined for that FDL level. (See Figure 9.)

Functionally Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 99 | 98 | 97 | 60 | 50 |

Accuracy Percentage

FIGURE 9—FUNCTIONAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—ACCURACY

**15.11 Physical Road Classification Metrics—**Vendors shall:

a. State number of Physically Distinct Levels in database (PDL)
b. State proportion of entire database in each PDL (by percentage of total number of links)
c. Describe the methodology used to separate the network into Physically Distinct Levels. If a standard set of classifications is used, such as AASHTO or FHWA, that standard should be specified and the appropriate documentation made available for review upon request.
d. Define the distinct levels
e. Describe how the PDL in the network are connected. Examples include:
    1. Topologically upwards, where the highest level is contiguous and each subsequent level, although they may not be individually contiguous, form a complete connected network when they are incrementally included.
    2. Topologically disconnected, where the individual levels when incrementally combined do not form a contiguous network.
f. State the connectivity for each level in the network. Provide a detailed breakdown indicating whether the level is contiguous with the one above it and if it is not, the percentage of that level that is disconnected.
g. State the proportion of links in the database that are labeled by the vendor to indicate one-way only travel.
h. State the proportion of navigable segments in the database that are labeled as one way in relation to the total number of navigable segments in the database.

15.11.1 CURRENTNESS MATRIX—State the currentness date for each level in month/year format. (See Figure 10.)

Physically Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 6/7/93 | 6/7/93 | 4/5/92 | 4/5/92 | MM/YY |

Current as of

FIGURE 10—PHYSICAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—CURRENTNESS

15.11.2 COMPLETENESS—Number of links by PDL included in the database in proportion to the total number of links by PDL for the area coverage defined for that PDL level.

Physically Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 99 | 98 | 97 | 75 | 65 |

Percentage of Completeness

FIGURE 11—PHYSICAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—COMPLETENESS

15.11.3 ACCURACY—Number of links by PDL, included in the database that are correctly classified in proportion to the total number of links by PDL for the area of coverage defined for that PDL level.

Physically Distinct Level

| Level 1 | Level 2 | Level 3 | Level 4 | Level N |
|---|---|---|---|---|
| 99 | 98 | 97 | 60 | 50 |

Accuracy Percentage

FIGURE 12—PHYSICAL ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE—ACCURACY

**15.12 Physical Characteristics Road Classification Metrics**

15.12.1 PHYSICAL CHARACTERISTICS—PRECISION CONSIDERATIONS

*15.12.1.1 Number of Lanes*—Number of lanes may be indicated by:

a. Multilane versus single lane
b. Ramps (i.e., 1-2, 3-4 5+)
c. Actual count

*15.12.1.2 Speed*—Speed may be indicated several ways, including but not limited to:

a. Actual speed
b. Average speed limit
c. Speed ranges, i.e., (25-35, 35-50, 55+)
d. Relative (high, moderate & low)

Indicate miles/hour or kilometer/hour for all but relative.

*15.12.1.3 Paved*—Paving type may be indicated several ways, including but not limited to:

a. Paved/non-paved (binary)
b. Non-paving types (sand, gravel, etc.)

*15.12.1.4 Divided Highways* are those in which the two directions of traffic are separated by a physical barrier. Highways may be indicated as:

*a.* Divided/not divided (binary)
*b.* Divider type (crossable/non-crossable)

| Physical road characteristic | Coverage | Completeness | Accuracy | Precision | Correctness |
|---|---|---|---|---|---|
| controlled access | | | | X | |
| partially controlled access | | | | X | |
| divided | | | | X | |
| double digitized | | | | X | |
| under/overpass | | | | X | |
| time reversible | | | | X | |
| toll | | | | X | |
| number of lanes | | | | exact or range | |
| speed (in mph or kph) | | | | absolute, range, relative, or average | |
| urban/rural | | | | X | |
| paved | | | | binary or type | |
| ramp | | | | X | |
| turning lanes | | | | X | |
| ferries | | | | X | |
| private roads | | | | X | |
| roads planned | | | | X | |
| roads under construction | | | | X | |

speed can be measured in miles/hour or kilometers/hour
"X" = "not practical to measure"

FIGURE 13—PHYSICAL CHARACTERISTICS ROAD CLASSIFICATION METRICS—MATRIX EXAMPLE

**15.13 Special Routing Road Classification Metrics**

15.13.1 SCENIC—Vendor shall define

a. Source(s)
b. Completeness
c. Currentness by source
d. Accuracy
e. Area of coverage

15.13.2 SOURCE(S)—Indicate the source or sources of scenic designation for the database. Specify source by area of coverage, if appropriate.

The following measures should be indicated by individual source of scenic designation.