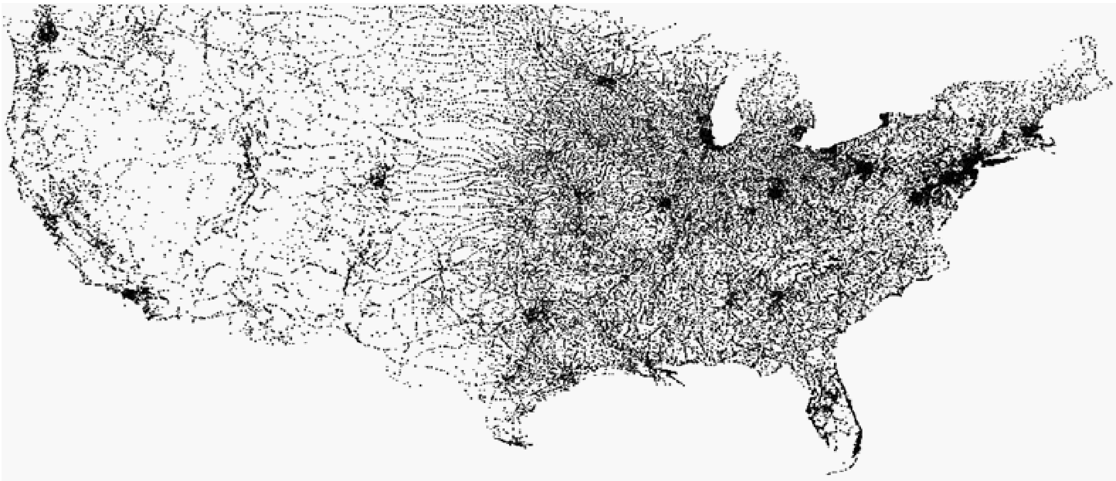
SQL Anywhere® Server
Spatial Data Support

Contents

About this book

This book describes the SQL Anywhere spatial data support and how the spatial features can be used to generate and analyze spatial data.

The following image represents the distributions of cities and towns across the United States and is one example of the interesting operations you can perform on spatial data.



About the SQL Anywhere documentation

The complete SQL Anywhere documentation is available in four formats:

- **DocCommentXchange** DocCommentXchange is a community for accessing and discussing SQL Anywhere documentation on the web.

  To access the documentation, go to http://dcx.sybase.com.

- **HTML Help** On Windows platforms, the HTML Help contains the complete SQL Anywhere documentation, including the books and the context-sensitive help for SQL Anywhere tools.

  To access the documentation, choose **Start** » **Programs** » **SQL Anywhere 12** » **Documentation** » **HTML Help (English)**.

- **Eclipse** On Unix platforms, the complete Help is provided in Eclipse format. To access the documentation, run *sadoc* from the *bin32* or *bin64* directory of your SQL Anywhere installation.

- **PDF** The complete set of SQL Anywhere books is provided as a set of Portable Document Format (PDF) files. You must have a PDF reader to view information.

To access the PDF documentation on Windows operating systems, choose **Start** » **Programs** » **SQL Anywhere 12** » **Documentation** » **PDF (English)**.

To access the PDF documentation on Unix operating systems, use a web browser to open */documentation/en/pdf/index.html* under the SQL Anywhere installation directory.

Documentation conventions

This section lists the conventions used in this documentation.

Operating systems

SQL Anywhere runs on a variety of platforms. Typically, the behavior of the software is the same on all platforms, but there are variations or limitations. These are commonly based on the underlying operating system (Windows, Unix), and seldom on the particular variant (IBM AIX, Windows Mobile) or version.

To simplify references to operating systems, the documentation groups the supported operating systems as follows:

- **Windows** The Microsoft Windows family includes platforms that are used primarily on server, desktop, and laptop computers, as well as platforms used on mobile devices. Unless otherwise specified, when the documentation refers to Windows, it refers to all supported Windows-based platforms, including Windows Mobile.

  Windows Mobile is based on the Windows CE operating system, which is also used to build a variety of platforms other than Windows Mobile. Unless otherwise specified, when the documentation refers to Windows Mobile, it refers to all supported platforms built using Windows CE.

- **Unix** Unless otherwise specified, when the documentation refers to Unix, it refers to all supported Unix-based platforms, including Linux and Mac OS X.

For the complete list of platforms supported by SQL Anywhere, see "Supported platforms" [*SQL Anywhere 12 - Introduction*].

Directory and file names

Usually references to directory and file names are similar on all supported platforms, with simple transformations between the various forms. In these cases, Windows conventions are used. Where the details are more complex, the documentation shows all relevant forms.

These are the conventions used to simplify the documentation of directory and file names:

- **Uppercase and lowercase directory names** On Windows and Unix, directory and file names may contain uppercase and lowercase letters. When directories and files are created, the file system preserves letter case.

  On Windows, references to directories and files are *not* case sensitive. Mixed case directory and file names are common, but it is common to refer to them using all lowercase letters. The SQL Anywhere installation contains directories such as *Bin32* and *Documentation*.

On Unix, references to directories and files *are* case sensitive. Mixed case directory and file names are not common. Most use all lowercase letters. The SQL Anywhere installation contains directories such as *bin32* and *documentation*.

The documentation uses the Windows forms of directory names. You can usually convert a mixed case directory name to lowercase for the equivalent directory name on Unix.

- **Slashes separating directory and file names** The documentation uses backslashes as the directory separator. For example, the PDF form of the documentation is found in *install-dir\Documentation\en\PDF* (Windows form).

  On Unix, replace the backslash with the forward slash. The PDF documentation is found in *install-dir/documentation/en/pdf*.

- **Executable files** The documentation shows executable file names using Windows conventions, with a suffix such as *.exe* or *.bat*. On Unix, executable file names have no suffix.

  For example, on Windows, the network database server is *dbsrv12.exe*. On Unix, it is *dbsrv12*.

- ***install-dir*** During the installation process, you choose where to install SQL Anywhere. The environment variable SQLANY12 is created and refers to this location. The documentation refers to this location as *install-dir*.

  For example, the documentation may refer to the file *install-dir/readme.txt*. On Windows, this is equivalent to *%SQLANY12%\readme.txt*. On Unix, this is equivalent to *$SQLANY12/readme.txt* or *${SQLANY12}/readme.txt*.

  For more information about the default location of *install-dir*, see "SQLANY12 environment variable" [*SQL Anywhere Server - Database Administration*].

- ***samples-dir*** During the installation process, you choose where to install the samples included with SQL Anywhere. The environment variable SQLANYSAMP12 is created and refers to this location. The documentation refers to this location as *samples-dir*.

  To open a Windows Explorer window in *samples-dir*, choose **Start** » **Programs** » **SQL Anywhere 12** » **Sample Applications And Projects**.

  For more information about the default location of *samples-dir*, see "SQLANYSAMP12 environment variable" [*SQL Anywhere Server - Database Administration*].

Command prompts and command shell syntax

Most operating systems provide one or more methods of entering commands and parameters using a command shell or command prompt. Windows command prompts include Command Prompt (DOS prompt) and 4NT. Unix command shells include Korn shell and bash. Each shell has features that extend its capabilities beyond simple commands. These features are driven by special characters. The special characters and features vary from one shell to another. Incorrect use of these special characters often results in syntax errors or unexpected behavior.

The documentation provides command line examples in a generic form. If these examples contain characters that the shell considers special, the command may require modification for the specific shell.

The modifications are beyond the scope of this documentation, but generally, use quotes around the parameters containing those characters or use an escape character before the special characters.

These are some examples of command line syntax that may vary between platforms:

- **Parentheses and curly braces** Some command line options require a parameter that accepts detailed value specifications in a list. The list is usually enclosed with parentheses or curly braces. The documentation uses parentheses. For example:

  ```
  -x tcpip(host=127.0.0.1)
  ```

  Where parentheses cause syntax problems, substitute curly braces:

  ```
  -x tcpip{host=127.0.0.1}
  ```

  If both forms result in syntax problems, the entire parameter should be enclosed in quotes as required by the shell:

  ```
  -x "tcpip(host=127.0.0.1)"
  ```

- **Semicolons** On Unix, semicolons should be enclosed in quotes.

- **Quotes** If you must specify quotes in a parameter value, the quotes may conflict with the traditional use of quotes to enclose the parameter. For example, to specify an encryption key whose value contains double-quotes, you might have to enclose the key in quotes and then escape the embedded quote:

  ```
  -ek "my \"secret\" key"
  ```

  In many shells, the value of the key would be `my "secret" key`.

- **Environment variables** The documentation refers to setting environment variables. In Windows shells, environment variables are specified using the syntax *%ENVVAR%*. In Unix shells, environment variables are specified using the syntax *$ENVVAR* or *${ENVVAR}*.

Contacting the documentation team

We would like to receive your opinions, suggestions, and feedback on this Help.

You can leave comments directly on help topics using DocCommentXchange. DocCommentXchange (DCX) is a community for accessing and discussing SQL Anywhere documentation. Use DocCommentXchange to:

- View documentation
- Check for clarifications users have made to sections of documentation
- Provide suggestions and corrections to improve documentation for all users in future releases

Go to http://dcx.sybase.com.

Finding out more and requesting technical support

Newsgroups

If you have questions or need help, you can post messages to the Sybase iAnywhere newsgroups listed below.

When you write to one of these newsgroups, always provide details about your problem, including the build number of your version of SQL Anywhere. You can find this information by running the following command: **dbeng12 -v**.

The newsgroups are located on the *forums.sybase.com* news server.

The newsgroups include the following:

- sybase.public.sqlanywhere.general
- sybase.public.sqlanywhere.linux
- sybase.public.sqlanywhere.mobilink
- sybase.public.sqlanywhere.product_futures_discussion
- sybase.public.sqlanywhere.replication
- sybase.public.sqlanywhere.ultralite
- ianywhere.public.sqlanywhere.qanywhere

For web development issues, see http://groups.google.com/group/sql-anywhere-web-development.

Newsgroup disclaimer
iAnywhere Solutions has no obligation to provide solutions, information, or ideas on its newsgroups, nor is iAnywhere Solutions obliged to provide anything other than a systems operator to monitor the service and ensure its operation and availability.

iAnywhere Technical Advisors, and other staff, assist on the newsgroup service when they have time. They offer their help on a volunteer basis and may not be available regularly to provide solutions and information. Their ability to help is based on their workload.

Developer Centers

The **SQL Anywhere Tech Corner** gives developers easy access to product technical documentation. You can browse technical white papers, FAQs, tech notes, downloads, techcasts and more to find answers to your questions as well as solutions to many common issues. See http://www.sybase.com/developer/library/sql-anywhere-techcorner.

The following table contains a list of the developer centers available for use on the SQL Anywhere Tech Corner:

Name	URL	Description
SQL Anywhere .NET Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/microsoft-net	Get started and get answers to specific questions regarding SQL Anywhere and .NET development.
PHP Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/php	An introduction to using the PHP (PHP Hypertext Preprocessor) scripting language to query your SQL Anywhere database.
SQL Anywhere Windows Mobile Developer Center	www.sybase.com/developer/library/sql-anywhere-techcorner/windows-mobile	Get started and get answers to specific questions regarding SQL Anywhere and Windows Mobile development.

Getting started with spatial data

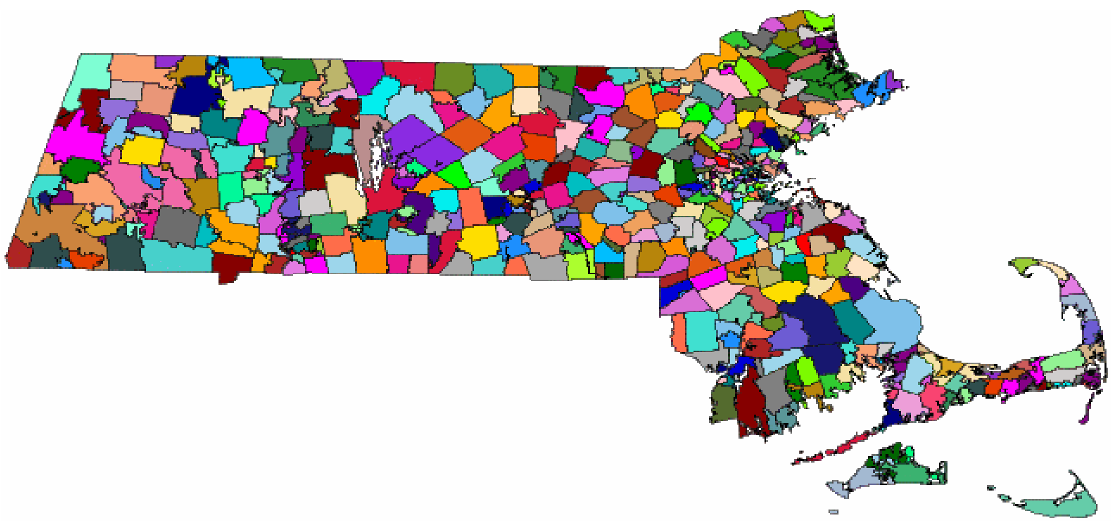
This section introduces SQL Anywhere spatial support and explains its purpose, describes the supported data types, and explains how to generate and analyze spatial data.

The spatial data documentation assumes you already have some familiarity with spatial reference systems and with the spatial data you intend to work with. If you do not, links to additional reading material can be found here: "Recommended reading on spatial topics" on page 17.

Note
Spatial data support for 32-bit Windows and 32-bit Linux requires a CPU that supports SSE2 instructions. This support is available with Intel Pentium 4 or later (released in 2001) and AMD Opteron or later (released in 2003).

Introduction to spatial data

Spatial data is data that describes the position, shape, and orientation of objects in a defined space. Spatial data in SQL Anywhere is represented as 2D geometries in the form of points, curves (line strings and strings of circular arcs), and polygons. For example, the following image shows the state of Massachusetts, representing the union of polygons representing zip code regions.



Two common operations performed on spatial data are calculating the distance between geometries, and determining the union or intersection of multiple objects. These calculations are performed using predicates such as intersects, contains, and crosses.

Example of how spatial data might be used

Spatial data support in SQL Anywhere lets application developers associate spatial information with their data. For example, a table representing companies could store the location of the company as a point, or store the delivery area for the company as a polygon. This could be represented in SQL as:

```
CREATE TABLE Locations(
   ID INT,
   ManagerName CHAR(16),
   StoreName CHAR(16),
   Address ST_Point,
   DeliveryArea ST_Polygon )
```

The spatial data type ST_Point in the example represents a single point, and ST_Polygon represents an arbitrary polygon. With this schema, the application could show all company locations on a map, or find out if a company delivers to a particular address using a query similar to the following:

```
CREATE VARIABLE @pt ST_Point;
SET @pt = ST_Geometry::ST_GeomFromText( 'POINT(1 1)' );

SELECT * FROM Locations
WHERE DeliveryArea.ST_Contains( @pt ) = 1
```

SQL Anywhere provides storage and data management features for spatial data, allowing you to store information such as geographic locations, routing information, and shape data.

These information pieces are stored as points and various forms of polygons and lines in columns defined with a corresponding **spatial data type** (such as ST_Point and ST_Polygon). You use methods and constructors to access and manipulate the spatial data. SQL Anywhere also provides a set of SQL spatial functions designed for compatibility with other products.

Object-oriented properties of spatial data types

- Sub-types are more specific than parent type.
- Sub-types inherit methods of parent type.
- Sub-types can be automatically converted to parent type.
- Columns or variables can store sub-types. For example, a column of type ST_Geometry(SRID=4326) can store spatial values of any type.
- Column or variable typed with a parent type can be cast to, or treated as, a sub-type.

See also

- "Supported spatial data types and their hierarchy" on page 18
- "Spatial compatibility functions" on page 292

Spatial reference systems (SRS) and Spatial reference identifiers (SRID)

In the context of spatial databases, the defined space in which geometries are described is called a **spatial reference system (SRS)**. A spatial reference system defines, at minimum:

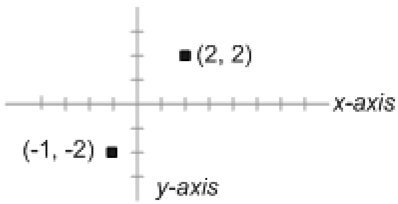
- Units of measure of the underlying coordinate system (degrees, meters, and so on)
- Maximum and minimum coordinates (also referred to as the bounds)
- Default linear unit of measure
- Whether the data is planar or spheroid data
- Projection information for transforming the data to other SRSs

Every spatial reference system has an identifier called a **Spatial Reference Identifier (SRID)**. When SQL Anywhere performs operations like finding out if a geometry touches another geometry, it uses the SRID to look up the spatial reference system definition so that it can perform the calculations properly for that spatial reference system. In a SQL Anywhere database, each SRID must be unique.

By default, SQL Anywhere adds the following spatial reference systems to a new database:

- **Default - SRID 0** This is the default spatial reference system used when constructing a geometry and the SRID is not specified in the SQL and is not present in the value being loaded.

  Default is a Cartesian spatial reference system that works with data on a flat, two dimensional plane. Any point on the plane can be defined using a single pair of x, y coordinates where x and y have the bounds -1,000,000 to 1,000,000. Distances are measured using perpendicular coordinate axis. This spatial reference system is assigned SRID of **0**.

  Cartesian is a planar type of spatial reference system.

- **WGS 84 - SRID 4326** The WGS 84 standard provides a spheroidal reference surface for the Earth. It is the spatial reference system used by the Global Positioning System (GPS). The coordinate origin of WGS 84 is the Earth's center, and is considered accurate up to ±1 meter. WGS stands for World Geodetic System.

  WGS 84 Coordinates are in degrees, where the first coordinate is longitude with bounds -180 to 180, and the second coordinate is latitude with bounds -90 to 90.

  The default unit of measure for WGS 84 is METRE, and it is a round-Earth type of spatial reference system.

- **WGS 84 (planar) - SRID 1000004326** WGS 84 (planar) is similar to WGS 84 except that it uses equi-rectangular projection, which distorts length, area and other computations. For example, at the equator in SRID 1000004326, 1 degree longitude is approximately 111 km. At 80 degrees north, 1 degree of longitude is approximately 19 km. But SRID 1000004326 treats 1 degree of longitude as approximately 111 km at *all* latitudes. The amount of distortion of lengths in the 1000004326 is considerable—off by a factor of 10 or more—and the distortion factor varies depending on the location of the geometries relative to the center of the spatial reference system as well. Consequently, 1000004326 should not be used for distance and area calculations. It should only be used for relationship predicates such as ST_Contains, ST_Touches, ST_Covers, and so on.

The default unit of measure for WGS 84 (planar) is DEGREE, and it is a flat-Earth type of spatial reference system.

See also: "Limitations of flat-Earth spatial reference systems" on page 7, and "Supported spatial predicates" on page 23.

- **sa_planar_unbounded - SRID 2,147,483,646** For internal use only.
- **sa_octahedral_gnomonic - SRID 2,147,483,647** For internal use only.

Since you can define a spatial reference system however you want and can assign any SRID number, the spatial reference system definition (projection, coordinate system, and so on) must accompany the data as it moves between databases or is converted to other SRSs. For example, when you unload spatial data to WKT, the definition for the spatial reference system is included at the beginning of the file.

Installing additional spatial reference systems using the sa_install_feature system procedure

SQL Anywhere also provides thousands of predefined SRSs for use. However, these SRSs are not installed in the database by default when you create a new database. You use the sa_install_feature system procedure to add them. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

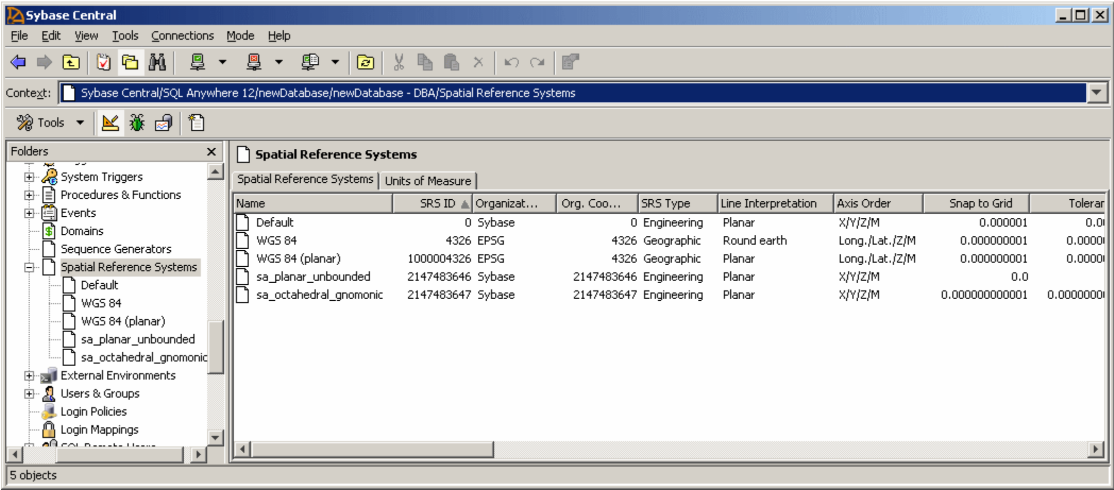
You can find descriptions of these additional spatial reference systems at spatialreference.org and www.epsg-registry.org/.

Determining the list of spatial reference systems currently in the database

Spatial reference system information is stored in the ISYSSPATIALREFERENCESYSTEM system table. The SRIDs for the SRSs are used as primary key values in this table. The database server uses SRID values to look up the configuration information for a spatial reference system so that it can interpret the otherwise abstract spatial coordinates as real positions on the Earth. See "SYSSPATIALREFERENCESYSTEM system view" [*SQL Anywhere Server - SQL Reference*].

You can find the list of spatial reference systems by querying the SYSSPATIALREFERENCESYSTEM system view. Each row in this view defines a spatial reference system.

You can also look in the **Spatial Reference Systems** folder in Sybase Central to see the list of spatial reference systems installed in the database:



Compatibility with popular mapping applications

Some popular web mapping and visualization applications such as Google Earth, Bing Maps, and ArcGIS Online, use a spatial reference system with a Mercator projection that is based on a spherical model of the Earth. This spherical model ignores the flattening at the Earth's poles and can lead to errors of up to 800m in position and up to 0.7 percent in scale, but it also allows applications to perform projection more efficiently.

In the past, applications assigned SRID 900913 to this spatial reference system. However, EPSG has since released this projection as SRID 3857. For compatibility with applications requiring 900913, you can use the sa_install_feature to install the additional predefined spatial reference systems provided by SQL Anywhere, and then manually copy SRID 3857 to 900913.

See also

- "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*]
- "SYSSPATIALREFERENCESYSTEM system view" [*SQL Anywhere Server - SQL Reference*]
- "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "Flat-Earth and round-Earth representations" on page 6

Units of measure

Geographic features can be measured in degrees of latitude, radians, or other angular units of measure. Every spatial reference system must explicitly state the name of the unit in which geographic coordinates are measured, and must include the conversion from the specified unit to a radian.

If you are using a projected coordinate system, the individual coordinate values represent a linear distance along the surface of the Earth to a point. Coordinate values can be measured by the meter, foot, mile, or yard. The projected coordinate system must explicitly state the linear unit of measure in which the coordinate values are expressed.

The following units of measure are automatically installed in any new SQL Anywhere database:

- **meter** A linear unit of measure. Also known as International metre. SI standard unit. Defined by ISO 1000.
- **metre** A linear unit of measure. An alias for meter. SI standard unit. Defined by ISO 1000.
- **radian** An angular unit of measure. SI standard unit. Defined by ISO 1000:1992.
- **degree** An angular unit of measure (pi()/180.0 radians).
- **planar degree** A linear unit of measure. Defined as 60 nautical miles. A linear unit of measure used for geographic spatial reference systems with PLANAR line interpretation.

Installing more predefined units of measure using the sa_install_feature system procedure

SQL Anywhere also provides dozens more predefined units of measure for use. However, these units of measure are not installed in the database by default when you create a new database. You use the sa_install_feature system procedure to add them. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

You can find descriptions of these additional units of measure at www.epsg-registry.org/. On the webpage, type the name of the unit of measure in the **Name** field, pick **Unit of Measure (UOM)** from the **Type** field, and then click **Search**.

See also

- "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*]
- "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "LINEAR UNIT OF MEASURE clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "ANGULAR UNIT OF MEASURE clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "SYSUNITOFMEASURE system view" [*SQL Anywhere Server - SQL Reference*]

Flat-Earth and round-Earth representations

SQL Anywhere supports both flat-Earth and round-Earth representations. **Flat-Earth** spatial reference systems represent the entire Earth on a flat, two dimensional plane (planar), and use a simple 2D Euclidean geometry. Lines between points are straight (except for circular strings), and geometries cannot wrap over the edge (cross the dateline).

Round-Earth spatial reference systems use an ellipsoid to represent the Earth. Points are mapped to the ellipsoid for computations, all lines follow the shortest path and arc toward the pole, and geometries can cross the date line.

Both flat-Earth and round-Earth representations have their limitations. There is not a single ideal map projection that best represents all features of the Earth, and depending on the location of an object on the Earth, distortions may affect its area, shape, distance, or direction.

Limitations of round-Earth spatial reference systems

When working with a round-Earth spatial reference system such as WGS 84, many operations are not available. For example, computing distance is restricted to points or collections of points.

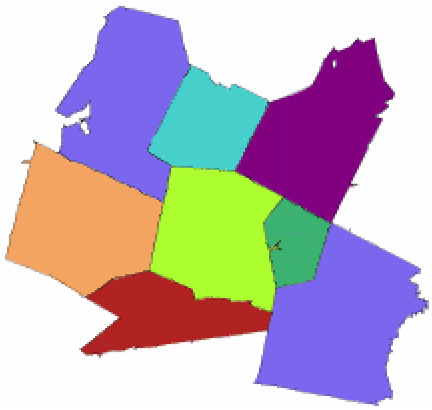
Some predicates and set operations are also not available.

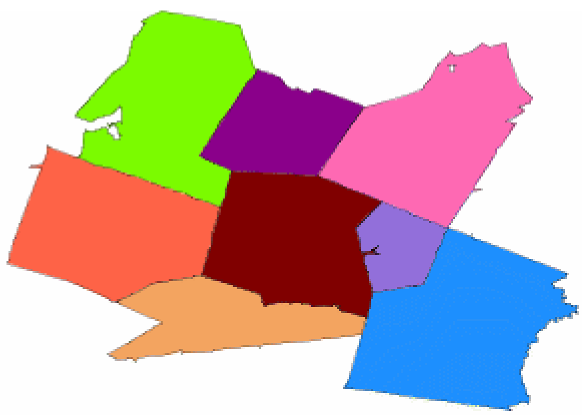
Circularstrings are not allowed in round-Earth spatial reference systems.

Computations in round-Earth spatial reference systems are more expensive than the corresponding computation in a flat-Earth spatial reference system.

Limitations of flat-Earth spatial reference systems

A flat-Earth spatial reference system is a planar spatial reference system that has a projection defined for it. **Projection** resolves distortion issues that occur when using a flat-Earth spatial reference system to operate on round-Earth data. For example of the distortion that occurs if projection is not used, the next two images show the same group of zip code regions in Massachusetts. The first image shows the data in a SRID 3586, which is a projected planar spatial reference system specifically for Massachusetts data. The second image shows the data in a planar spatial reference system without projection (SRID 1000004326). The distortion manifests itself in the second image as larger-than-actual distances, lengths, and areas that cause the image to appear horizontally stretched.





While more calculations are possible in flat-Earth spatial reference systems, calculations are only accurate for areas of bounded size, due to the effect of projection.

You can project round-Earth data to a flat-Earth spatial reference system to perform distance computations with reasonable accuracy provided you are working within distances of a few hundred kilometers. To project the data to a planar projected spatial reference system, you use the ST_Transform method. See “ST_Transform method for type ST_Geometry” on page 208.

How snap-to-grid and tolerance impact spatial calculations

Snap-to-grid is the action of positioning a geometry so it aligns with intersection points on a grid. In the context of spatial data, a **grid** is a framework of lines that is laid down over a two-dimensional representation of a spatial reference system. SQL Anywhere uses a square grid.

By default, SQL Anywhere automatically sets the grid size so that 12 significant digits can be stored for every point within the X and Y bounds of a spatial reference system. For example, if the range of X values is from -180 to 180, and the range of Y values is from -90 to 90, the database server sets the grid size to 1e-9 (0.000000001). That is, the distance between both horizontal and vertical grid lines is 1e-9. The intersection points of the grid line represents all the points that can be represented in the spatial reference system. When a geometry is created or loaded, each point's X and Y coordinates are snapped to the nearest points on the grid.

Tolerance defines the distance within which two points or parts of geometries are considered equal. This can be thought of as all geometries being represented by points and lines drawn by a marker with a thick tip, where the thickness is equal to the tolerance. Any parts that touch when drawn by this thick marker are considered equal within tolerance. If two points are exactly equal to tolerance apart, they are considered not equal within tolerance.

Note that tolerance can cause extremely small geometries to become invalid. Lines which have length less than tolerance are invalid (because the points are equivalent), and similarly polygons where all points are equal within tolerance are considered invalid.

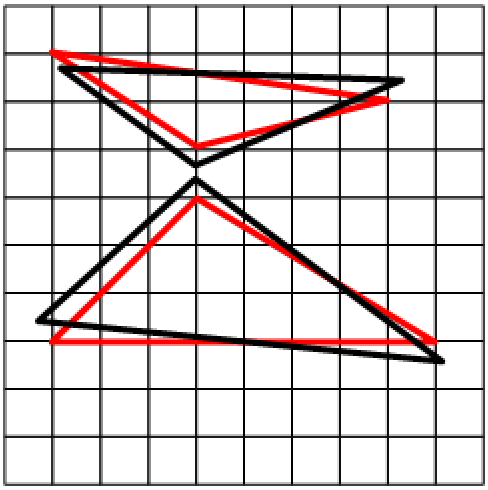
Snap-to-grid and tolerance are set on the spatial reference system. They are always specified in the linear unit of measure for the spatial reference system. Snap-to-grid and tolerance work together to overcome issues with inexact arithmetic and imprecise data. However, you should be aware of how their behavior can impact the results of spatial operations.

Note
For planar spatial reference systems, setting grid size to 0 is never recommended as it can result in incorrect results from spatial operations. For round-Earth spatial reference systems, grid size and tolerance must be set to 0. SQL Anywhere uses fixed grid size and tolerance on an internal projection when performing round-Earth operations.

The following examples illustrate the impact of grid size and tolerance settings on spatial calculations.

Example 1: Snap-to-grid impacts intersection results

Two triangles (shown in black) are loaded into a spatial reference system where tolerance is set to grid size, and the grid in the diagram is based on the grid size. The red triangles represent the black triangles after the triangle vertexes are snapped to the grid. Notice how the original triangles (black) are well within tolerance of each other, whereas the snapped versions in red do not. ST_Intersects returns 0 for these two geometries. If tolerance was larger than the grid size, ST_Intersects would return 1 for these two geometries.

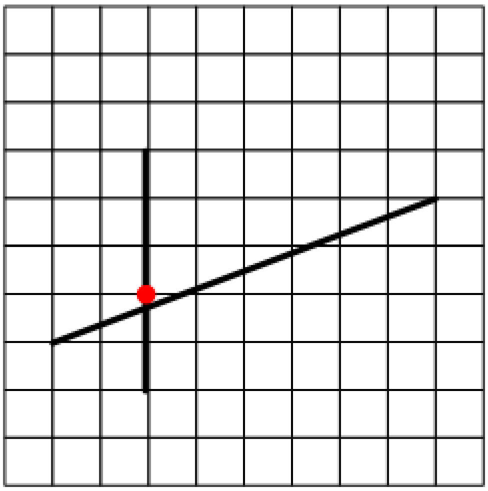


Example 2: Tolerance impacts intersection results

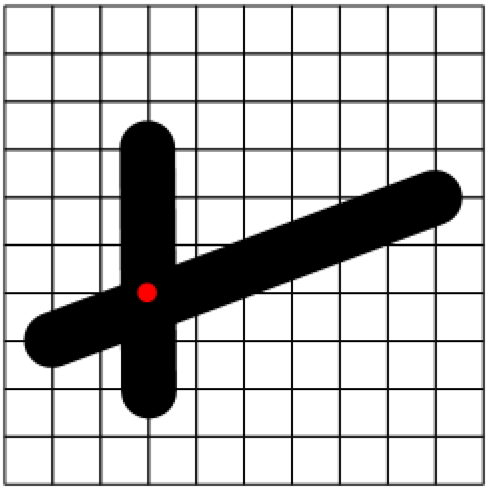
In the following example, two lines lie in a spatial reference system where tolerance is set to 0. The intersection point of the two lines is snapped to the nearest vertex in the grid. Since tolerance is set to 0, a test to determine if the intersection point of the two lines intersects the diagonal line returns false.

In other words, the following expression returns 0 when tolerance is 0:

```
vertical_line.ST_Intersection( diagonal_line ).ST_Intersects( diagonal_line )
```

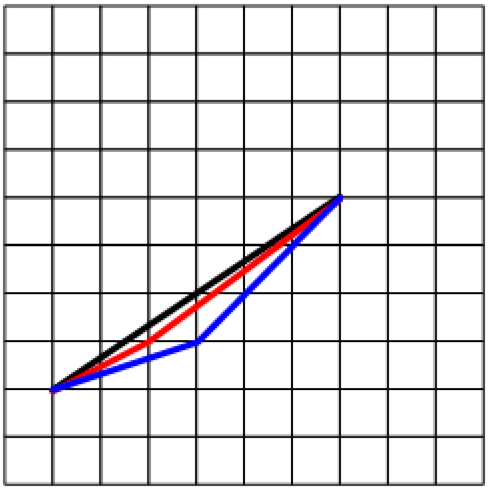


Setting the tolerance to grid size (the default), however, causes the intersection point to be inside the thick diagonal line. So a test of whether the intersection point intersects the diagonal line within tolerance would pass:



Example 3: Tolerance and transitivity

In spatial calculations when tolerance is in use, transitivity does not necessary hold. For example, suppose you have the following three lines in a spatial reference system where the tolerance is equal to the grid size:



The ST_Equals method considers the black and red lines to be equivalent within tolerance, and the red and blue lines to be equivalent within tolerance but black line and the blue line are not equivalent within tolerance. ST_Equals is not transitive.

Note that ST_OrderingEquals considers each of these lines to be different, and ST_OrderingEquals is transitive.

Example 4: Impact of grid and tolerance settings on imprecise data

Suppose you have data in a projected planar spatial reference system which is mostly accurate to within 10 centimeters, and always accurate to within 10 meters. You have three choices:

1. Use the default grid size and tolerance that SQL Anywhere selects, which is normally greater than the precision of your data. Although this provides maximum precision, predicates such as ST_Intersects, ST_Touches, and ST_Equals may give results that are different than expected for some geometries, depending on the accuracy of the geometry values. For example, two adjacent polygons that share a border with each other may not return true for ST_Intersect if the leftmost polygon has border data a few meters to the left of the rightmost polygon.

2. Set the grid size to be small enough to represent the most accuracy in any of your data (10 centimeters, in this case) and at least four times smaller than the tolerance, and set tolerance to represent the distance to which your data is always accurate to (10 meters, in this case). This strategy means your data is stored without losing any precision, and that predicates will give the expected result even though the data is only accurate within 10 meters.

3. Set grid size and tolerance to the precision of your data (10 meters, in this case). This way your data is snapped to within the precision of your data, but for data that is more accurate than 10 meters the additional accuracy is lost.

   In many cases predicates will give the expected results but in some cases they will not. For example, if two points are within 10 centimeters of each other but near the midway point of the grid intersections, one point will snap one way and the other point will snap the other way, resulting in the points being about 10 meters apart. For this reason, setting grid size and tolerance to match the precision of your data is not recommended in this case.

See also

- "SNAP TO GRID clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "TOLERANCE clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "ST_Equals method for type ST_Geometry" on page 154
- "ST_SnapToGrid method for type ST_Geometry" on page 187
- "ST_OrderingEquals method for type ST_Geometry" on page 178
- "Supported spatial predicates" on page 23
- "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]
- "ALTER SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]

Indexes on spatial columns

Indexes on spatial data can reduce the cost of evaluating relationships between geometries. For example, suppose that you are considering changing the boundaries of your sales regions and want to determine the impact on existing customers. To determine which customers are located within a proposed sales region, you could use the ST_Within method to compare a point representing each customer address to a polygon representing the sales region. Without any index, the database server must test every address point in the

Customer table against the sales region polygon to determine if it should be returned in the result, which could be expensive if the Customer table is large, and inefficient if the sales region is small. An index including the address point of each customer may help to return results faster. If a predicate can be added to the query relating the sales region to the states which it overlaps, results might be obtained even faster using an index that includes both the state code and the address point.

There is no special procedure required when creating an index on spatial data (for example, CREATE INDEX statement, **Create Index wizard**, and so on). However, when creating indexes on spatial data, it is recommended that you do not include more than one spatial column in the index, and that you position the spatial column last in the index definition.

Also, in order to include a spatial column in an index, the column must have a SRID constraint. See “Using a SRID as column constraint” on page 32.

Spatial queries *may* benefit from a clustered index, but other uses of the table need to be considered before deciding to use a clustered index. You should consider, and test, the types of queries that are likely to be performed to see whether performance improves with clustered indexes.

While you can create text indexes on a spatial column, they offer no advantage over regular indexes; regular indexes are recommended instead.

See also

- “Working with indexes” [*SQL Anywhere Server - SQL Usage*]
- “Using clustered indexes” [*SQL Anywhere Server - SQL Usage*]
- “CREATE INDEX statement” [*SQL Anywhere Server - SQL Reference*]
- “ALTER INDEX statement” [*SQL Anywhere Server - SQL Reference*]

Spatial data type syntax based on ANSI SQL UDTs

The SQL/MM standard defines spatial data support in terms of user-defined extended types (UDTs) built on the ANSI/SQL CREATE TYPE statement. Although SQL Anywhere does not support user-defined types, the SQL Anywhere spatial data support has been implemented as though they are supported.

Instantiating instances of a UDT

You can instantiate a user-defined type to define a constructor as follows:

NEW *type-name*(*argument-list*)

For example, a query could contain the following to instantiate two ST_Point values:

```
SELECT NEW ST_Point(), NEW ST_Point(3,4)
```

SQL Anywhere matches *argument-list* against defined constructors using the normal overload resolution rules. An error is returned in the following situations:

- If NEW is used with a type that is not a user-defined type

- If the user-defined type is not instantiable (for example, ST_Geometry is not an instantiable type).
- If there is no overload that matches the supplied argument types

See also:

- “Accessing and manipulating spatial data” on page 59
- “ST_Point type” on page 259

Using instance methods

User defined types can have instance methods defined. Instance methods are invoked on a value of the type as follows:

*value-expression***.***method-name***(** *argument-list* **)**

For example, the following selects the X coordinate of the myTable.centerpoint column:

```
SELECT centerpoint.ST_X() FROM myTable;
```

Note that if there was a user ID called centerpoint, the database server would find the construct `centerpoint.ST_X()` to be **ambiguous**. This is because the statement could mean "call the user-defined function ST_X owned by user centerpoint"--the incorrect intention of the statement--or it could mean "call the ST_X method on the myTable.centerpoint column" (the correct meaning). The database server resolves such ambiguity by first performing a case-insensitive search for a user named centerpoint. If a user named centerpoint is found, the database server proceeds as though a user-defined function called ST_X and owned by user centerpoint is being called. If no user called centerpoint is found, the database server treats the construct as a method call and calls the ST_X method on the myTable.centerpoint column.

An instance method invocation gives an error in the following cases:

- If the declared type of the *value-expression* is not a user-defined type
- If the named method is not defined in the declared type of *value-expression* or one of its supertypes
- If *argument-list* does not match one of the defined overloads for the named method.

See also:

- “ST_X() method for type ST_Point” on page 269

Using static methods

In addition to instance methods, the ANSI/SQL standard allows user-defined types to have static methods associated with them. These are invoked using the following syntax:

*type-name***::***method-name***(** *argument-list* **)**

For example, the following instantiates an ST_Point by parsing text:

```
SELECT ST_Geometry::ST_GeomFromText('POINT( 5 6 )')
```

A static method invocation gives an error in the following cases:

- If the declared type of *value-expression* is not a user-defined type
- If the named method is not defined in the declared type of *value expression* or one of its supertypes
- If *argument-list* does not match one of the defined overloads for the named method

See also:

- “ST_Point type” on page 259
- “ST_GeomFromText method for type ST_Geometry” on page 158

Using static aggregate methods (SQL Anywhere extension)

As an extension to ANSI/SQL, SQL Anywhere supports static methods that implement user-defined aggregates. For example:

```
SELECT ST_Geometry::ST_AsSVGAggr(T.geo) FROM table T
```

All of the overloads for a static method must be aggregate or none of them may be aggregate.

A static aggregate method invocation gives an error in the following cases:

- If a static method invocation would give an error
- If a built-in aggregate function would give an error
- If a WINDOW clause is specified

See also:

- “ST_AsSVGAggr method for type ST_Geometry” on page 107

Using type predicates

The ANSI/SQL standard defines type predicates that allow a statement to examine the dynamic type of a value. The syntax is as follows:

value **IS** [**NOT**] **OF (** [**ONLY**] *type-name*,**...)**

If *value* is NULL, the predicate returns UNKNOWN. Otherwise, the dynamic type of *value* is compared to each of the elements in the *type-name* list. If ONLY is specified, there is a match if the dynamic type is exactly the specified type. Otherwise, there is a match if the dynamic type is the specified type or any derived type (sub-type).

If the dynamic type of *value* matches one of the elements in the list, TRUE is returned, otherwise FALSE.

For example, the following returns T:

```
SELECT IF DT.x IS OF ( ST_Point ) THEN 'T' ENDIF
FROM ( SELECT ST_Geometry::ST_GeomFromText('POINT(5 6)') x ) DT
```


See also:

- “Search conditions” [*SQL Anywhere Server - SQL Reference*]
- “ST_Point type” on page 259
- “ST_GeomFromText method for type ST_Geometry” on page 158

Using the TREAT expression for subtypes

The ANSI/SQL standard defines a sub-type treatment expression that allows a cast from a base type to a sub-type (derived type). The syntax is as follows:

TREAT(*value-expression* **AS** *target-subtype* **)**

The following example casts ST_Geometry to sub-type ST_Point:

```
SELECT TREAT( DT.x AS ST_Point )
FROM ( SELECT ST_Geometry::ST_GeomFromText('POINT(5 6)') x ) DT
```

If no error condition is raised, the result is the *value-expression* with declared type of *target-subtype*.

The sub-type treatment expression gives an error in the following cases:

- If *value-expression* is not a user-defined type
- If *target-subtype* is not a sub-type of the declared type of *value-expression*
- If the dynamic type of *value-expression* is not a sub-type of *target-subtype*

See also:

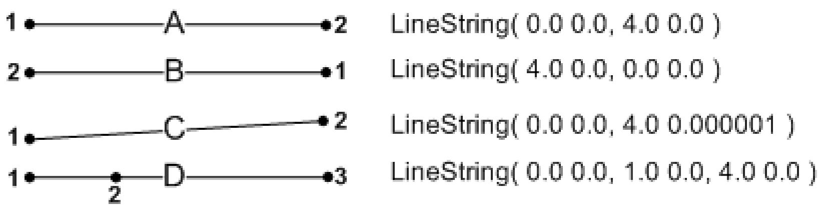
- “TREAT function [Data type conversion]” [*SQL Anywhere Server - SQL Reference*]
- “ST_Point type” on page 259
- “ST_GeomFromText method for type ST_Geometry” on page 158

Comparing geometries using ST_Equals and ST_OrderingEquals

There are two methods you can use to test whether a geometry is equal to another geometry: ST_Equals, and ST_OrderingEquals. These methods perform the comparison differently, and return a different result.

- **ST_Equals** The order in which points are specified does not matter, and point comparison takes tolerance into account. Geometries are also considered equal if they occupy the same space, within tolerance. This means that if two linestrings occupy the same space, yet one is defined with more points, they are still considered equal.
- **ST_OrderingEquals** With ST_OrderingEquals, the order in which points are specified matters, and point comparisons do not take tolerance into account. That is, points must be exactly the same, including being specified in the exact same order, for the geometries to be considered equal.

To illustrate the difference in results when comparisons are made using ST_Equals versus ST_OrderingEquals, consider the following lines. ST_Equals considers them all equal (assuming line C is within tolerance). However, ST_OrderingEquals does not consider any of them equal.



How SQL Anywhere performs comparisons of geometries

The database server uses ST_OrderingEquals to perform operations such as GROUP BY and DISTINCT.

For example, when processing the following query the server considers two rows to be equal if the two shape expressions have ST_OrderingEquals() = 1:

```
SELECT DISTINCT Shape FROM SpatialShapes;
```

SQL statements can compare two geometries using the equal to operator (=), or not equal to operator (<> or !=), including search conditions with a subquery and the ANY or ALL keyword.. Geometries can also be used in an IN search condition. For example, `geom1 IN (geom-expr1, geom-expr2, geom-expr3)`. For all of these search conditions, equality is evaluated using the ST_OrderingEquals semantics.

You cannot use other comparison operators to determine if one geometry is less than or greater than another (for example, `geom1 < geom2` is not accepted). This means you cannot include geometry expressions in an ORDER BY clause. However, you can test for membership in a set.

Spatial permissions

To create, alter, or drop spatial reference systems and units of measure, you must be a user with DBA permissions or belong to the SYS_SPATIAL_ADMIN_ROLE group. See "Granting group membership to existing users or groups" [*SQL Anywhere Server - Database Administration*].

Recommended reading on spatial topics

- For a good primer on the different approaches that are used to map and measure the earth's surface (geodesy), and the major concepts surrounding coordinate (or spatial) reference systems, go to www.epsg.org/guides/index.html and select Geodetic Awareness.
- OGC OpenGIS Implementation Specification for Geographic information - Simple feature access: www.opengeospatial.org/standards/sfs
- International Standard ISO/IEC 13249-3:2006: www.iso.org/iso/catalogue_detail.htm?csnumber=38651
- Scalable Vector Graphics (SVG) 1.1 Specification: www.w3.org/TR/SVG11/index.html
- Geographic Markup Language (GML) specification: www.opengeospatial.org/standards/gml
- KML specification: www.opengeospatial.org/standards/kml
- JavaScript Object Notation (JSON): json.org
- GeoJSON specification: geojson.org/geojson-spec.html

Compliance and support

This section describes SQL Anywhere's compliance with existing standards and provides a high level view of the supported features.

Compliance with spatial standards

SQL Anywhere spatial complies with the following standards:

- **International Organization for Standardization (ISO)** SQL Anywhere geometries conform to the ISO standards for defining spatial user-types, routines, schemas, and for processing spatial data. SQL Anywhere conforms to the specific recommendations made by the International Standard ISO/IEC 13249-3:2006. See http://www.iso.org/iso/catalogue_detail.htm?csnumber=38651.

- **Open Geospatial Consortium (OGC) Geometry Model** SQL Anywhere geometries conform to the OGC OpenGIS Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option version 1.2.0 (OGC 06-104r3). See http://www.opengeospatial.org/standards/sfs.

  SQL Anywhere uses the standards recommended by the OGC to ensure that spatial information can be shared between different vendors and applications.

  To ensure compatibility with SQL Anywhere spatial geometries, it is recommended that you adhere to the standards specified by the OGC.

- **SQL Multimedia (SQL/MM)** SQL Anywhere follows the SQL/MM standard, and uses the prefix **ST_** for all method and function names.

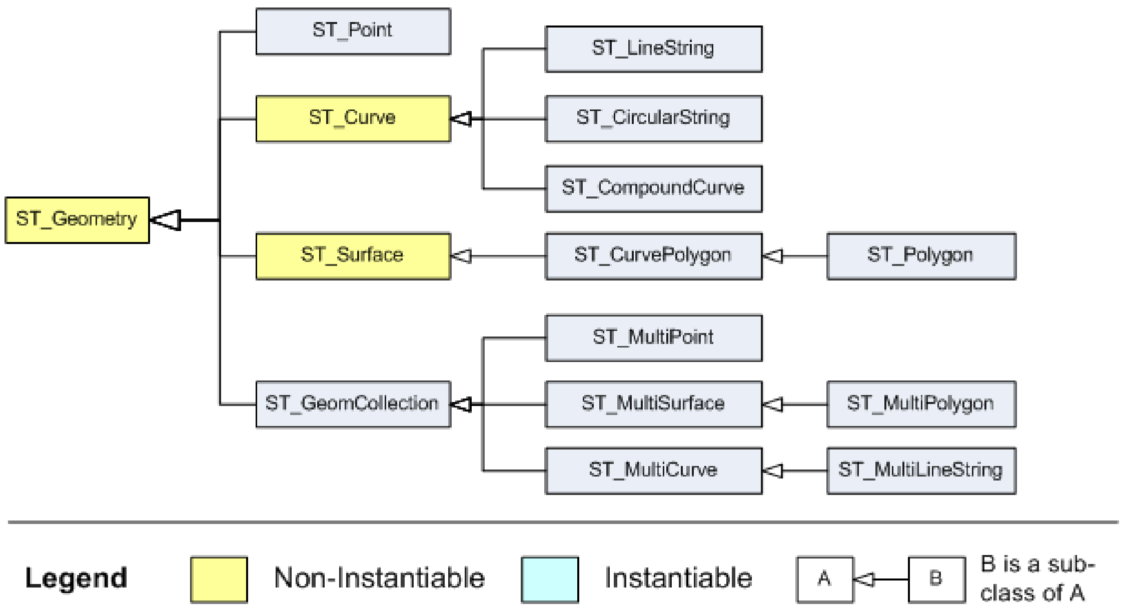
  SQL/MM is an international standard that defines how to store, retrieve, and process spatial data using SQL. Spatial data type hierarchies such as ST_Geometry are one of the methods used to retrieve spatial data. The ST_Geometry hierarchy includes a number of subtypes such as ST_Point, ST_Curve, and ST_Polygon. With the SQL/MM standard, every spatial value included in a query must be defined in the same spatial reference system.

Supported spatial data types and their hierarchy

SQL Anywhere follows the SQL Multimedia (SQL/MM) standard for storing and accessing geospatial data. A key component of this standard is the use of the ST_Geometry hierarchy to define how geospatial data is created. Within the hierarchy, the prefix ST is used for all data types (also referred to as classes or just types).

When a column is identified as a specific type, the values of the type and its sub-classes can be stored in the column. For example, a column identified as ST_GeomCollection can also store the ST_MultiPoint, ST_MultiSurface, ST_MultiCurve, ST_MultiPolygon, and ST_MultiLineString values.

The following diagram illustrates the hierarchy of the ST_Geometry data type and its subtypes:



Descriptions of supported spatial data types

SQL Anywhere supports the following spatial data types:

- **Circular strings** A circular string is a collection of at least three points that typically make a curved line, although the points can be collinear. For more information, see “ST_CircularString type” on page 59

- **Compound curves** A compound curve is a collection of one or more linestrings, circular strings, or compound curves. For more information, see “ST_CompoundCurve type” on page 64.

- **Curve polygons** A curve polygon is similar to a polygon in that it has an exterior bounding ring and zero or more interior rings. However, more spatial data types are supported for the interior rings than for polygons (any ST_Curve value, for example). For more information, see "ST_CurvePolygon type" on page 74.

- **Geometries** The term geometry means the overarching type for objects such as points, linestrings, and polygons. The geometry type is the supertype for all supported spatial data types. For more information, see "ST_Geometry type" on page 88.

- **Geometry collections** A geometry collection is a collection of one or more geometries (such as points, lines, polygons, and so on). For more information, see "ST_GeomCollection type" on page 82.

- **Linestrings** A linestring is a line that connects two or more points in space. A linestring is a one-dimensional geometry with a specified length, but without any area. Linestrings can be characterized by whether they are simple or not simple, closed or not closed, where:

  - Simple means a linestring drawn between two points that does not cross itself.
  - Closed means a linestring that starts and ends at the same point.

  For example, a ring is an example of simple, closed linestring.

  For more information, see "ST_LineString type" on page 223.

  In GIS data, linestrings are typically used to represent rivers, roads, or delivery routes.

- **Multipoints** A multipoint is a collection of individual points. The boundary around these points is empty. For more information, see "ST_MultiPoint type" on page 240.

  In GIS data, multipoints are typically used to represent a set of locations.

- **Multipolygons** A multipolygon is one or more polygons defined together as a set.

  In SQL Anywhere, multipolygons are specified using the ST_MultiPolygon type. See "ST_MultiPolygon type" on page 244

  In GIS data, multipolygons are often used to represent geographic features such as a system of lakes or forestry reserves within a specific region.

- **Multilinestrings** A multilinestring is a collection of linestrings that connect two or more points in space.

  In GIS data, multilinestrings are often used to represent geographic features like rivers or a highway network.

  In SQL Anywhere, multilinestrings are specified using the ST_MultilineString type. See "ST_MultiLineString type" on page 235.

- **Points** A point defines a single location in space. A point geometry does not have length or area. A point always has an X and Y coordinate.

In GIS data, points are typically used to represent locations such as addresses, or geographic features such as a mountain.

In SQL Anywhere, points are specified using the ST_Point type. See "ST_Point type" on page 259.

- **Polygons** A polygon is a collection of points that represent a two dimensional surface. A polygons is constructed of one or more rings (boundaries)—an exterior bounding ring, and zero or more interior rings—and has an associated length and area.

  In GIS data, polygons are typically used to represent territories (counties, towns, states, and so on), lakes, and large geographic features such as parks.

  In SQL Anywhere, polygons are specified using the ST_Polygon type. See "ST_Polygon type" on page 273.

  See also: "Polygon ring orientation" on page 20

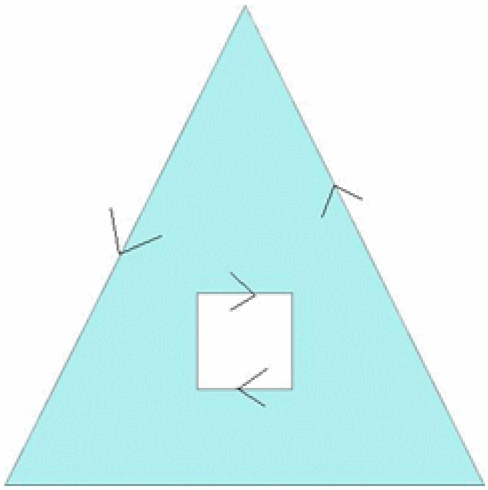
- **Multisurfaces** In SQL Anywhere, multisurfaces are specified using the ST_MultiSurface type. See "ST_MultiSurface type" on page 250.

Polygon ring orientation

In SQL Anywhere, internal spatial operations assume outer rings of polygons are in counter-clockwise orientation and interior rings are in the opposite (clockwise) orientation.

Polygons are automatically reoriented if created with a different ring orientation than what is defined for the spatial reference system. You control polygon ring orientation by specifying a polygon format when you create the spatial reference system (for example, the POLYGON FORMAT clause of the CREATE SPATIAL REFERENCE SYSTEM statement).

For example, suppose your spatial reference system defines the polygon format as counter-clockwise (the default). If you create a polygon and specify the points in a clockwise order `Polygon((0 0, `**`5 10, 10 0,`**` 0 0), (4 2, 4 4, 6 4, 6 2, 4 2))`, the database server automatically rearranges the points to be in counter-clockwise rotation, as follows: `Polygon((0 0, `**`10 0, 5 10,`**` 0 0), (4 2, 4 4, 6 4, 6 2, 4 2))`.



If the inner ring was specified before the outer ring, the outer ring would appear as the first ring

In order for polygon reorientation to work in round-Earth spatial reference systems, polygons are limited to 160° in diameter.

See also

- See “POLYGON FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

Supported import and export formats for spatial data

The following table lists the data and file formats supported by SQL Anywhere for importing and exporting spatial data:

Data format	Import	Export	Description
Well Known Text (WKT)	Yes	Yes	Geographic data expressed in ASCII text. This format is maintained by the Open Geospatial Consortium (OGC) as part of the Simple Features defined for the OpenGIS Implementation Specification for Geographic Information. See www.opengeospatial.org/standards/sfa. Here is an example of how a point might be represented in WKT: `'POINT(1 1)'`

Data format	Import	Export	Description
Well Known Binary (WKB)	Yes	Yes	Geographic data expressed as binary streams. This format is maintained by the OGC as part of the Simple Features defined for the OpenGIS Implementation Specification for Geographic Information. See www.opengeospatial.org/standards/sfa. Here is an example of how a point might be represented in WKB: '0101000000000000000000F03F000000000000F03F'
Extended Well Known Text (EWKT)	Yes	Yes	WKT format, but with SRID information embedded. This format is maintained as part of PostGIS, the spatial database extension for PostgreSQL. See postgis.refractions.net/. Here is an example of how a point might be represented in EWKT: 'srid=101;POINT(1 1)'
Extended Well Known Binary (EWKB)	Yes	Yes	WKB format, but with SRID information embedded. This format is maintained as part of PostGIS, the spatial database extension for PostgreSQL. See postgis.refractions.net/. Here is an example of how a point might be represented in EWKB: '010100002004000000000000000000F03F000000000000F03F'
Geographic Markup Language (GML)	No	Yes	XML grammar used to represent geographic spatial data. This standard is maintained by the Open Geospatial Consortium (OGC), and is intended for the exchange of geographic data over the internet. See www.opengeospatial.org/standards/gml. Here is an example of how a point might be represented in GML: <gml:Point> <gml:coordinates>1,1</gml:coordinates> </gml:Point>
KML	No	Yes	Formerly Google's Keyhole Markup Language, this XML grammar is used to represent geographic data including visualization and navigation aids and the ability to annotate maps and images. Google proposed this standard to the OGC. The OGC accepted it as an open standard which it now calls KML. See www.opengeospatial.org/standards/kml. Here is an example of how a point might be represented in KML: <Point> <coordinates>1,0</coordinates> </Point>

Data format	Import	Export	Description
ESRI shapefiles	Yes	No	A popular geospatial vector data format for representing spatial objects in the form of shapefiles (several files that are used together to define the shape). For more information about ESRI shapefile support, see “Support for ESRI shapefiles” on page 25.
GeoJSON	No	Yes	Text format that uses name/value pairs, ordered lists of values, and conventions similar to those used in common programming languages such as C, C++, C#, Java, JavaScript, Perl, and Python. GeoJSON is a subset of the JSON standard and is used to encode geographic information. SQL Anywhere supports the GeoJSON standard and provides the ST_AsGEOJSON method for converting SQL output to the GeoJSON format. See “ST_AsGeoJSON method for type ST_Geometry” on page 100. Here is an example of how a point might be represented in GeoJSON: `{"x" : 1, "y" : 1, "spatialReference" : {"wkid" : 4326}}` For more information about the GeoJSON specification, see geojson.org/geojson-spec.html.
Scalable Vector Graphic (SVG) files	No	Yes	XML-based format used to represent two-dimensional geometries. The SVG format is maintained by the World Wide Web Consortium (W3C). See www.w3.org/Graphics/SVG/. Here is an example of how a point might be represented in SVG: `<rect width="1" height="1" fill="deepskyblue" stroke="black" stroke-width="1" x="1" y="-1"/>`

Supported spatial predicates

A predicate is a conditional expression that, combined with the logical operators AND and OR, makes up the set of conditions in a WHERE, HAVING, or ON clause, or in an IF or CASE expression, or in a CHECK constraint. In SQL, a predicate may evaluate to TRUE, FALSE. In many contexts, a predicate that evaluates to UNKNOWN is interpreted as FALSE.

Spatial predicates are implemented as member functions that return 0 or 1. In order to test a spatial predicate, your query should compare the result of the function to 1 or 0 using the = or <> operator. For example:

```
SELECT * FROM SpatialShapes WHERE geometry.ST_IsEmpty() <> 1;
```

You use predicates when querying spatial data to answer such questions as: how close together are two or more geometries? Do they intersect or overlap? Is one geometry contained within another? If you are a delivery company, for example, you may use predicates to determine if a customer is within a specific delivery area.

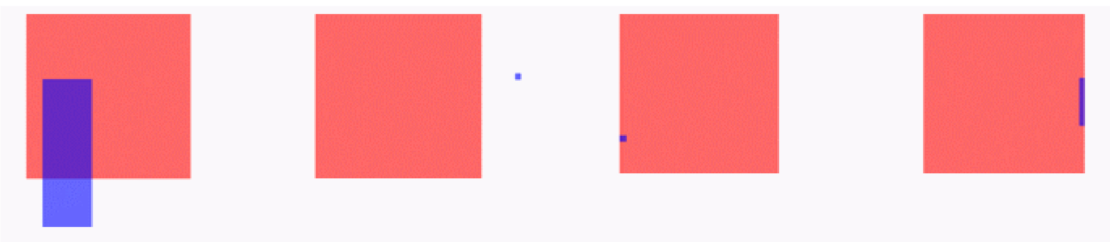
SQL Anywhere supports the following spatial predicates to help answer questions about the spatial relationship between geometries:

- "ST_Contains method for type ST_Geometry" on page 135
- "ST_Covers method for type ST_Geometry" on page 144
- "ST_CoveredBy method for type ST_Geometry" on page 142
- "ST_Crosses method for type ST_Geometry" on page 146
- "ST_Disjoint method for type ST_Geometry" on page 150
- "ST_IsEmpty method for type ST_Geometry" on page 169
- "ST_Equals method for type ST_Geometry" on page 154
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_Overlaps method for type ST_Geometry" on page 180
- "ST_Relate method for type ST_Geometry" on page 181
- "ST_Touches method for type ST_Geometry" on page 207
- "ST_Within method for type ST_Geometry" on page 211

Intuitiveness of spatial predicates

Sometimes the outcome of a predicate is not intuitive, so you should test special cases to make sure you are getting the results you want. For example, in order for a geometry to contain another geometry (`a.ST_Contains(b)=1`), or for a geometry to be within another geometry (`b.ST_Within(a)=1`), the interior of a and the interior of b must intersect, and no part of b can intersect the exterior of a. However, there are some cases where you would expect a geometry to be considered contained or within another geometry, but it is not.

For example, the following return 0 (a is red) for `a.ST_Contains(b)` and `b.ST_Within(a)`:



Case one and two are obvious; the purple geometries are not completely within the red squares. Case three and four, however, are not as obvious. In both of these cases, the purple geometries are only on the boundary of the red squares. ST_Contains does not consider the purple geometries to be within the red squares, even though they appear to be within them.

If your predicate tests return a different result for cases than desired, consider using the ST_Relate method to specify the exact relationship you are testing for. See "Test custom relationships using the ST_Relate method" on page 44.

Support for ESRI shapefiles

SQL Anywhere supports the Environmental System Research Institute, Inc. (ESRI) shapefile format. ESRI shapefiles are used to store geometry data and attribute information for the spatial features in a data set.

An ESRI shapefile includes three different files: *.shp*, *.shx*, and *.dbf*. The suffix for the main file is *.shp*, the suffix for the index file is *.shx*, and the suffix for the attribute columns is *.dbf*. All files share the same base name and are frequently combined in a single compressed file. SQL Anywhere can read all ESRI shapefiles with all shape types except MultiPatch. This includes shape types that include Z and M data.

The data in an ESRI shapefile usually contains multiple rows and columns. For example, the spatial tutorial loads a shapefile that contains zip code regions for Massachusetts. The shapefile contains one row for each zip code region, including the polygon information for the region. It also contains additional attributes (columns) for each zip code region, including the zip code name (for example, the string '02633') and other attributes.

To determine the types of the columns stored in a shapefile, use the sa_describe_shapefile system procedure. From the information returned by sa_describe_shapefile, you can create a table with the appropriate column names and types for the shapefile, or you can determine the *rowset-schema* to use with an OPENSTRING clause. You can then use LOAD TABLE USING FILE FORMAT SHAPEFILE to load the shapefile into a table, or use `... FROM OPENSTRING( FILE ) WITH( rowset-schema ) OPTION( FORMAT SHAPEFILE )` to retrieve the result set.

See also

- "sa_describe_shapefile system procedure" [*SQL Anywhere Server - SQL Reference*]
- "LOAD TABLE statement" [*SQL Anywhere Server - SQL Reference*]
- "Openstring expressions in a FROM clause" [*SQL Anywhere Server - SQL Reference*]
- "Tutorial: Experimenting with the spatial features" on page 47

For more information about ESRI shapefiles, see http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf.

Special notes on support and compliance

This section describes any special notes about SQL Anywhere support of spatial data including unsupported features and notable behavioral differences with other database products.

- **Geographies and geometries** Some vendors distinguish spatial objects by whether they are **geographies** (pertaining to objects on a round-Earth) or **geometries** (objects on a plane or a flat-Earth). In SQL Anywhere, all spatial objects are considered to be geometries, and the object's SRID indicates whether it is being operated on in a round-Earth or flat-Earth (planar) spatial reference system.

- **Unsupported methods**
  - ST_Buffer method
  - ST_LocateAlong method
  - ST_LocateBetween method
  - ST_Segmentize method
  - ST_Simplify method
  - ST_Distance_Spheroid method
  - ST_Length_Spheroid method

Spatial data usage topics

This section provides procedures for creating, accessing, and manipulating spatial data.

Create a spatial reference system

Use the following procedures to create a new spatial reference system using Sybase Central or Interactive SQL.

To create a spatial reference system (Sybase Central)

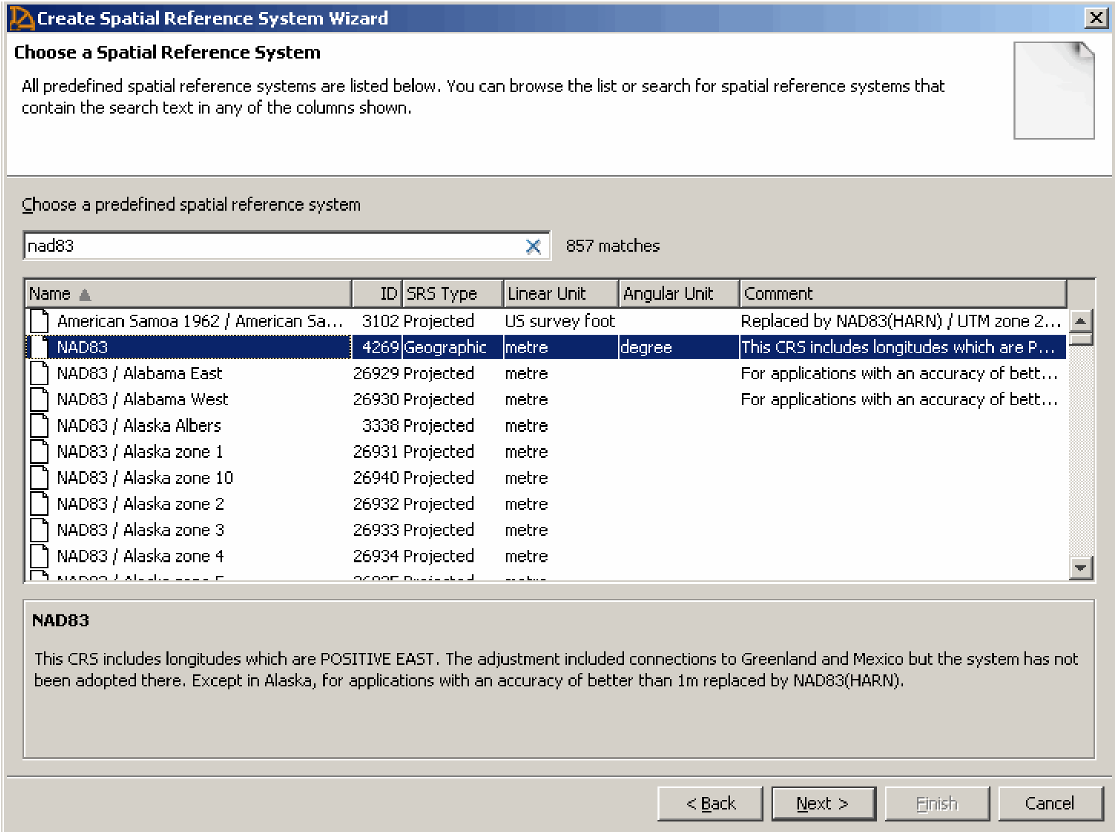
1. In Sybase Central, connect to the database as a user with DBA authority, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.

2. In the left pane, right-click **Spatial Reference Systems** » **New** » **Spatial Reference System**.

3. When you create a spatial reference system, you use an existing one as a template on which to base your settings. Therefore you should choose a spatial reference system that is similar to the one you want to create. Later, you can edit the settings.

   Select **Let Me Choose From The List Of All Predefined Spatial Reference Systems**, and then click **Next**.

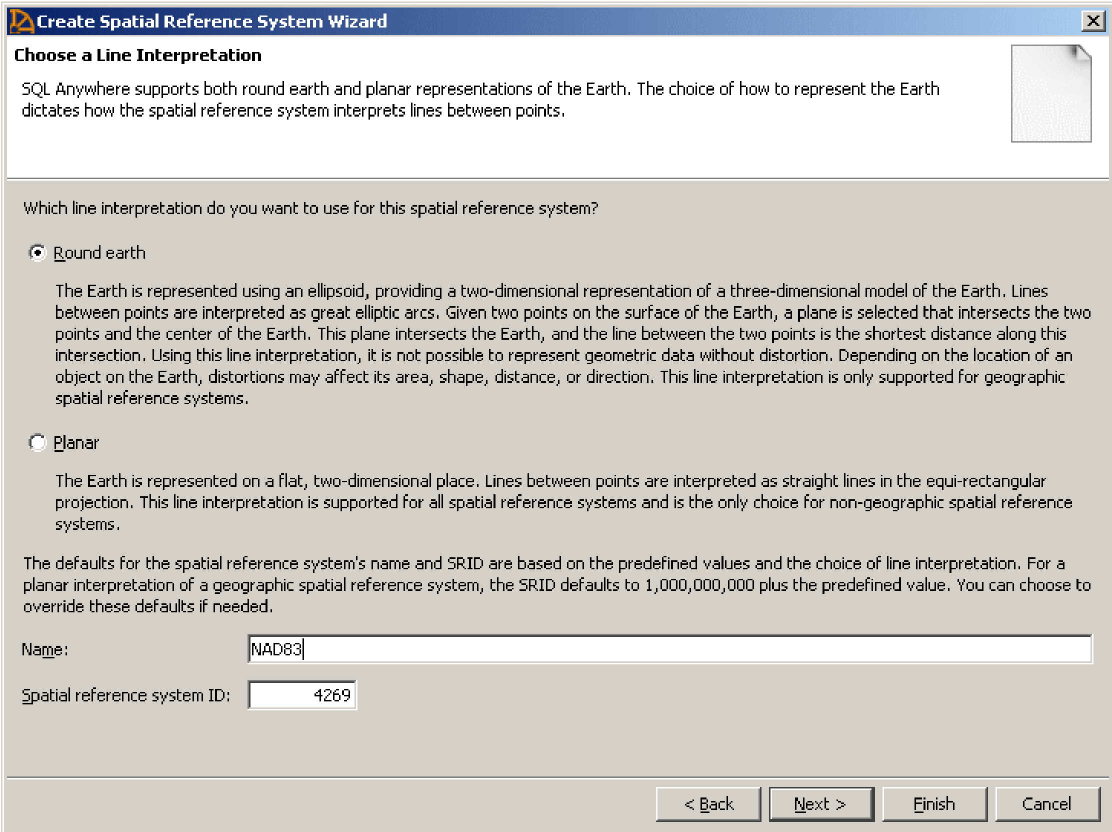
   The **Choose A Spatial Reference System** window appears.



4. You will create a spatial reference system based on the NAD83 spatial reference system so type **NAD83**. Note that as you type a name or ID in the **Choose A Predefined Spatial Reference Systems** field, the list of spatial reference systems moves to display the spatial reference system you want to use as a template.

5. Click **NAD83** and then click **Next**.

   The **Choose A Line Interpretation** window appears.



6. Select **Round Earth** as the line interpretation.

7. Specify **NAD83custom** in the **Name** field.

8. When you create a spatial reference system based on an existing spatial reference system, you set the *srs-id* value to be 1000000000 plus the Well Known value. For example, change the value in the **Spatial Reference System ID** field from 4269 to **1000004269**.

> **Note**
> When assigning a SRID, review the recommendations provided for ranges of numbers to avoid. These recommendations are found in the IDENTIFIED clause of the CREATE SPATIAL REFERENCE SYSTEM statement. See "IDENTIFIED BY clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

9. Click **Next**.

   The **Specify A Comment** window appears.

10. Optionally, specify a description for the spatial reference system, and then click **Next**.

11. Click **Finish**.

The definition for the spatial reference system appears.

12. If you are satisfied with the definition for the spatial reference system, click **Finish**.

    The new spatial reference system is added to the database.

To create a spatial reference system (SQL)

1. In Interactive SQL, connect to the database as a user with DBA authority, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.
2. Execute a CREATE SPATIAL REFERENCE SYSTEM statement. See "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

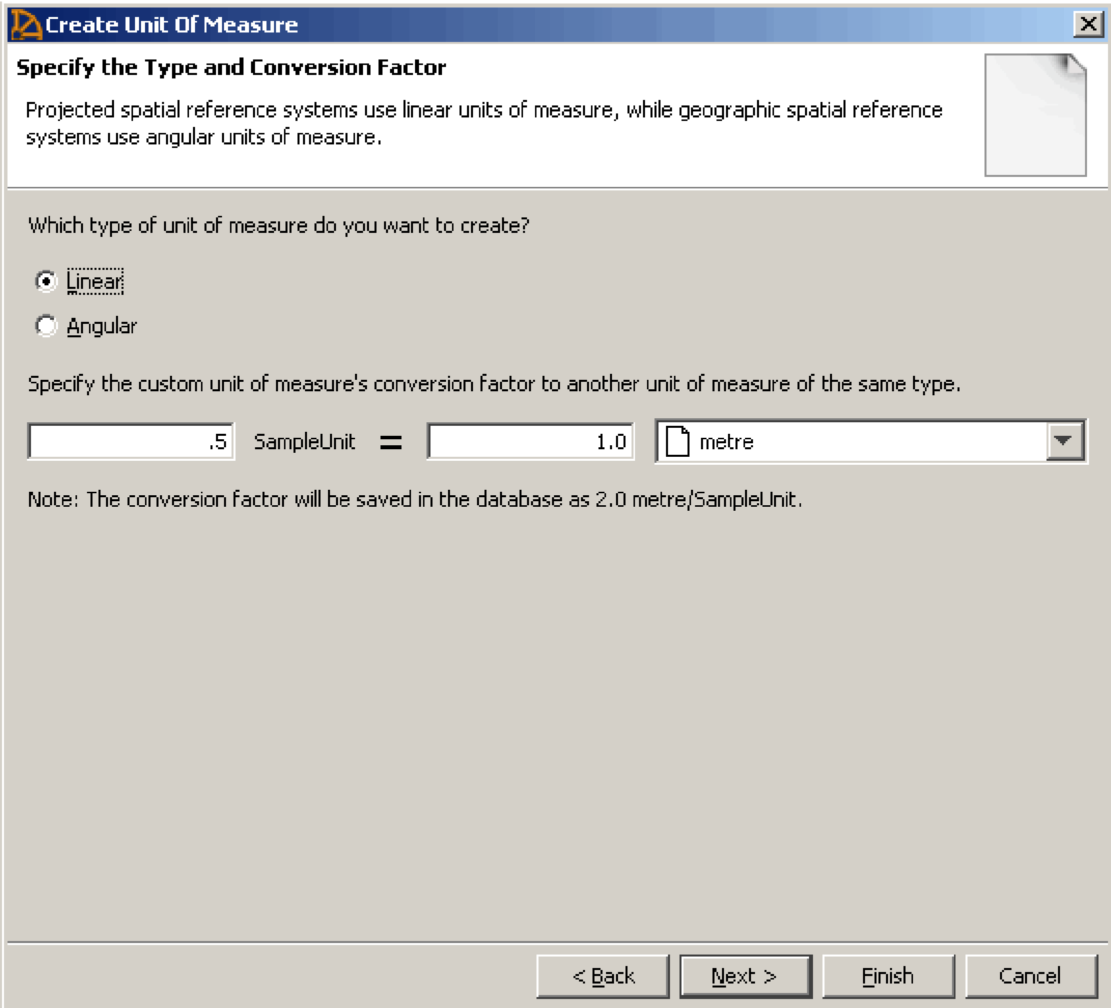
- "Spatial reference systems (SRS) and Spatial reference identifiers (SRID)" on page 2

Create a unit of measure

Use the following procedures to create a new unit of measure using Sybase Central or Interactive SQL.

To create a unit of measure (Sybase Central)

1. In Sybase Central, connect to the database as a user with DBA authority, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.
2. In the left pane, click **Spatial Reference Systems**.
3. In the right pane, click the **Units of Measure** tab.
4. Right-click the **Units of Measure** tab and click » **New** » **Unit Of Measure**.
5. Select **Create A Custom Unit of Measure**, and then click **Next.**
6. Specify a name in the **What Do You Want To Name The New Unit Of Measure?** field, and then click **Next**.
7. Select **Linear** in the **Which Type of Unit Of Measure Do You Want To Create?** field.



8. Follow the instructions in the **Create Unit Of Measure Wizard**.

9. Click **Finish**.

To create a unit of measure (SQL)

1. In Interactive SQL, connect to the database as a user with DBA authority, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.

2. Execute a CREATE SPATIAL UNIT OF MEASURE statement. See "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*]

See also

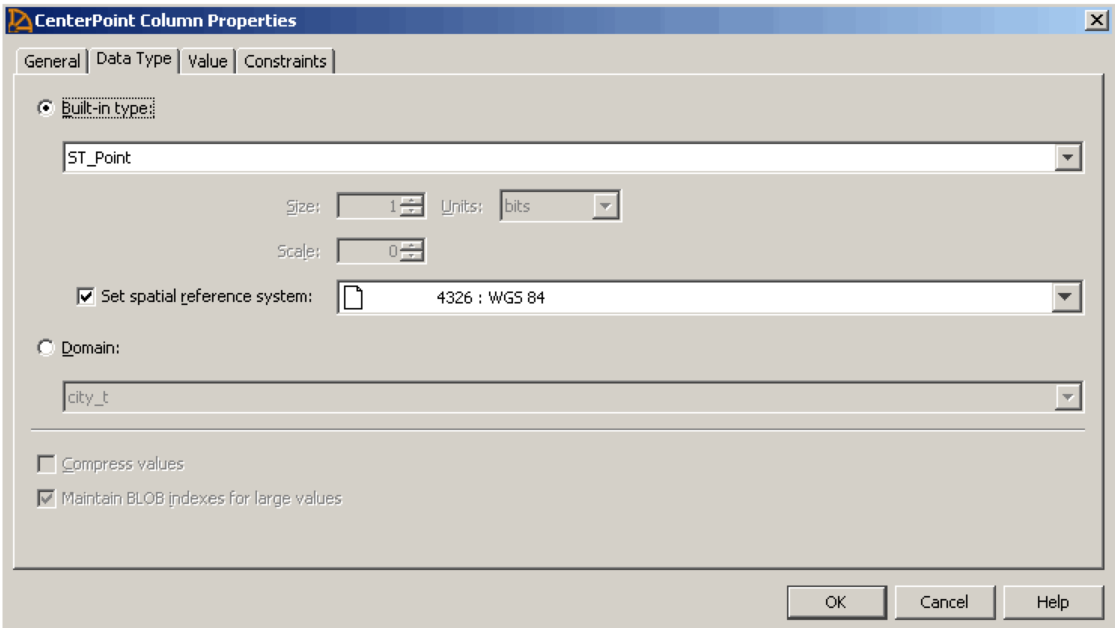
- "Units of measure" on page 5

Create a spatial column

Use the following procedures to create a spatial column in an existing table. You can use Sybase Central or SQL statements in Interactive SQL to add a new spatial column.

To add a new spatial column (Sybase Central)

1. In Sybase Central, connect to the database as a user with permissions to alter the table.
2. In the left pane, expand the **Tables** list.
3. Right-click a table and choose **New** » **Column**.
4. In the **Data Type** column, select a spatial data type. For example, choose **ST_Point**.
5. Set the spatial reference system.
   a. Right-click the data-type name and choose **Properties.**
   b. Click **Data Type**.
   c. Select **Set Spatial Reference System** and choose a spatial reference system from the dropdown list.



   d. Click **OK**.
6. Choose **File** » **Save**.

To add a new spatial column (SQL)

1. In Interactive SQL, connect to the database as a user with permissions to alter the table.

2. Execute an ALTER TABLE statement. See "ALTER TABLE statement" [*SQL Anywhere Server - SQL Reference*].

Example

The following statement adds a spatial column named Location to the Customers table. The new column is of spatial data type ST_Point, and has a declared SRID of 1000004326, which is a flat-Earth spatial reference system.

```
ALTER TABLE Customers
ADD Location ST_Point(SRID=1000004326);
```

See also

- "Supported spatial data types and their hierarchy" on page 18
- "Spatial reference systems (SRS) and Spatial reference identifiers (SRID)" on page 2

Using a SRID as column constraint

SRID constraints allow you to place restrictions on the values that can be stored in a spatial column. For example, execute the following statement to create a table named Test with a SRID constraint (SRID=4326) on the Geometry_2 column:

```
CREATE TABLE Test (
   ID INTEGER PRIMARY KEY,
   Geometry_1 ST_Geometry,
   Geometry_2 ST_Geometry(SRID=4326),
   );
```

This constraint means that only values associated with SRID 4326 can be stored in this column.

The column Geometry_1 is unconstrained and can store values associated with any SRID.

In order to include a spatial column in an index, the column must have a SRID constraint. For example, you cannot create an index on the Geometry_1 column. However, you can create an index on the Geometry_2 column.

If you have a table with an existing spatial column, you can use the ALTER TABLE statement to add a SRID constraint to a spatial column. For example, execute a statement similar to the following to add a constraint to the Geometry_1 column in the table named Test:

```
ALTER TABLE Test
   MODIFY Geometry_1 ST_Geometry(SRID=4326);
```

> **Note**
> If you add a spatial column to a table, you should make sure that the table has a primary key defined. Update and delete operations are not supported for a table that contains a spatial column unless a primary key is defined.

Create geometries

There are several methods for creating geometries in a database:

- **Load from Well Known Text (WKB) or Well Known Binary (WKB) formats** You can load or insert data in WKT or WKB formats. These formats are defined by the OGC, and all spatial database vendors support them. SQL Anywhere performs automatic conversion from these formats to geometry types. For an example of loading from WKT, see "Load spatial data from a Well Known Text (WKT) file" on page 37.

- **Load from ESRI shapefiles** You can load data in ESRI shapefile format. Following this method, you use the sa_describe_shapefile system procedure to determine the columns and spatial data types contained in the shapefile. Then, you can use the LOAD TABLE statement See "Tutorial: Experimenting with the spatial features" on page 47.

- **Use a SELECT...FROM OPENSTRING statement** You can execute a SELECT...OPENSTRING FORMAT SHAPEFILE statement on a file containing the spatial data. For example:

```
INSERT INTO world_cities( country, city, point )
   SELECT country, city, NEW ST_Point( longitude, latitude, 4326 )
      FROM OPENSTRING( FILE 'capitalcities.csv' )
           WITH(
                 country   CHAR(100),
                 city      CHAR(100),
                 latitude  DOUBLE,
                 longitude DOUBLE )
```

  See "Openstring expressions in a FROM clause" [*SQL Anywhere Server - SQL Reference*].

- **Create coordinate points by combining latitude and longitude values** You can combine latitude and longitude data to create a coordinate of spatial data type ST_Point. For example, if you had a table that already has latitude and longitude columns, you can create an ST_Point column that holds the values as a point using a statement similar to the following:

```
ALTER TABLE my_table
   ADD point AS ST_Point(SRID=4326)
   COMPUTE( NEW ST_Point( longitude, latitude, 4326 ) );
```

- **Create geometries using constructors and static methods** You can create geometries using constructors and static methods. See "Instantiating instances of a UDT" on page 12 and "Using static methods" on page 13.

View spatial data as images

When working with spatial data, you may want to view a geometry as an image to understand what the data represents. SQL Anywhere offers two ways of viewing geometries:

- **Spatial Preview tab** The **Spatial Preview** tab is available from the **Results** pane in Interactive SQL. It allows you to look at geometry values one at a time in the results.

- **Spatial Viewer** The **Spatial Viewer** is available from the **Tools** menu in Interactive SQL. It combines all geometries reflected in the results of a query into one image.

  Each instance of Interactive SQL is associated with a different connection to a database. When you open an instance of the **Spatial Viewer** from within Interactive SQL, that instance of **Spatial Viewer** remains associated with that instance of Interactive SQL, and shares the connection to the database.

  This means that when you execute a query in the **Spatial Viewer**, if you attempt to execute a query in the associated instance of Interactive SQL, you will get an error. Likewise, if you have multiple instances of the **Spatial Viewer** open that were created by the same instance of Interactive SQL, only one of those instances can execute a query at a time; the rest have to wait for the query to finish.

To view a geometry in Interactive SQL

1. Execute the following query in Interactive SQL:

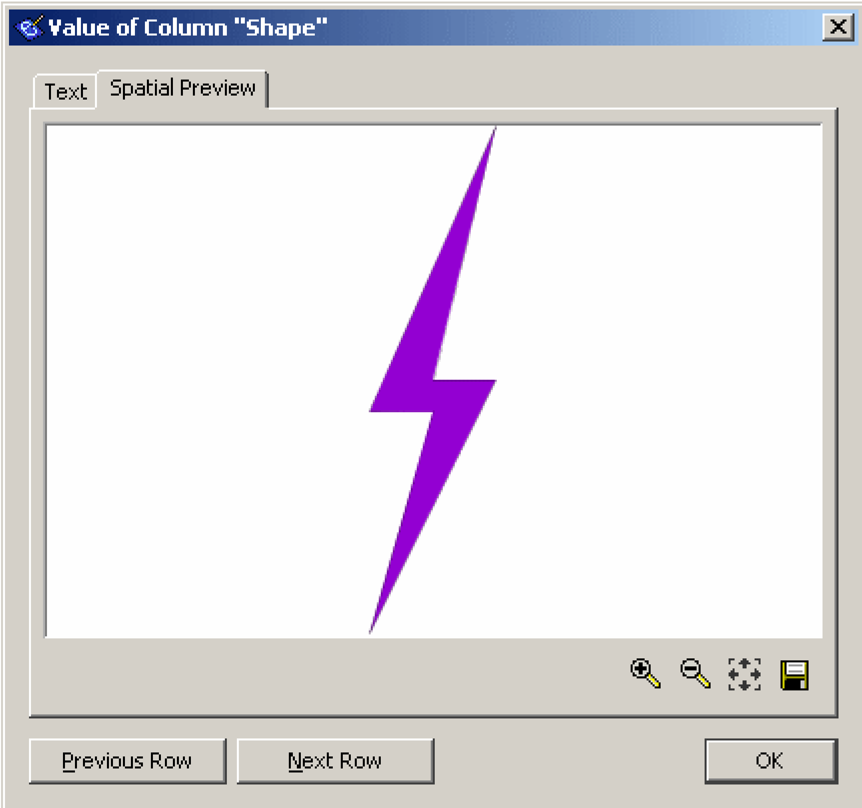
   ```
   SELECT * FROM SpatialShapes;
   ```

2. Double-click the any value in the Shapes column in the **Results** pane to open the value in the **Value** window.

   The value is displayed as text on the **Text** tab of the **Value** window.

   > **Note**
   > By default, Interactive SQL truncates values in the **Results** pane to 256 characters. If Interactive SQL returns an error indicating that the full column value could not be read, increase the truncation value. To do this, choose **Tools** » **Options** and pick **SQL Anywhere** in the left pane. On the **Results** tab, change **Truncation Length** to a high value such as 5000. Click **OK** to save your changes, and execute the query again.

3. Click the **Spatial Preview** tab to see the geometry as a Scalable Vector Graphic (SVG).

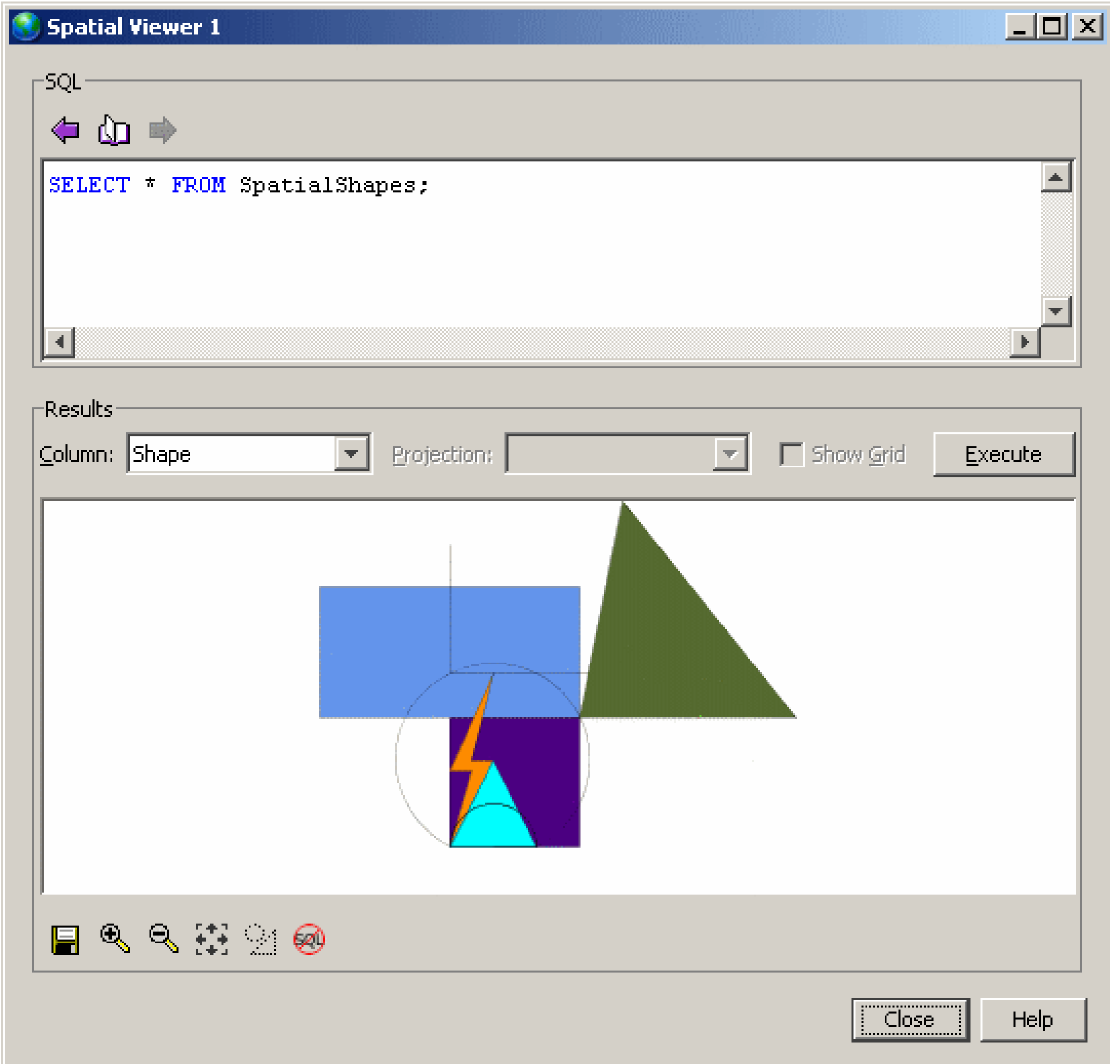


4. Use the **Previous Row** and **Next Row** buttons to view other rows in the result set.

To view a geometry using the Spatial Viewer

1. In Interactive SQL, select **Tools** » **Spatial Viewer**.
2. In the **Spatial Viewer**, execute the following query in the **SQL** pane and then click **Execute**:

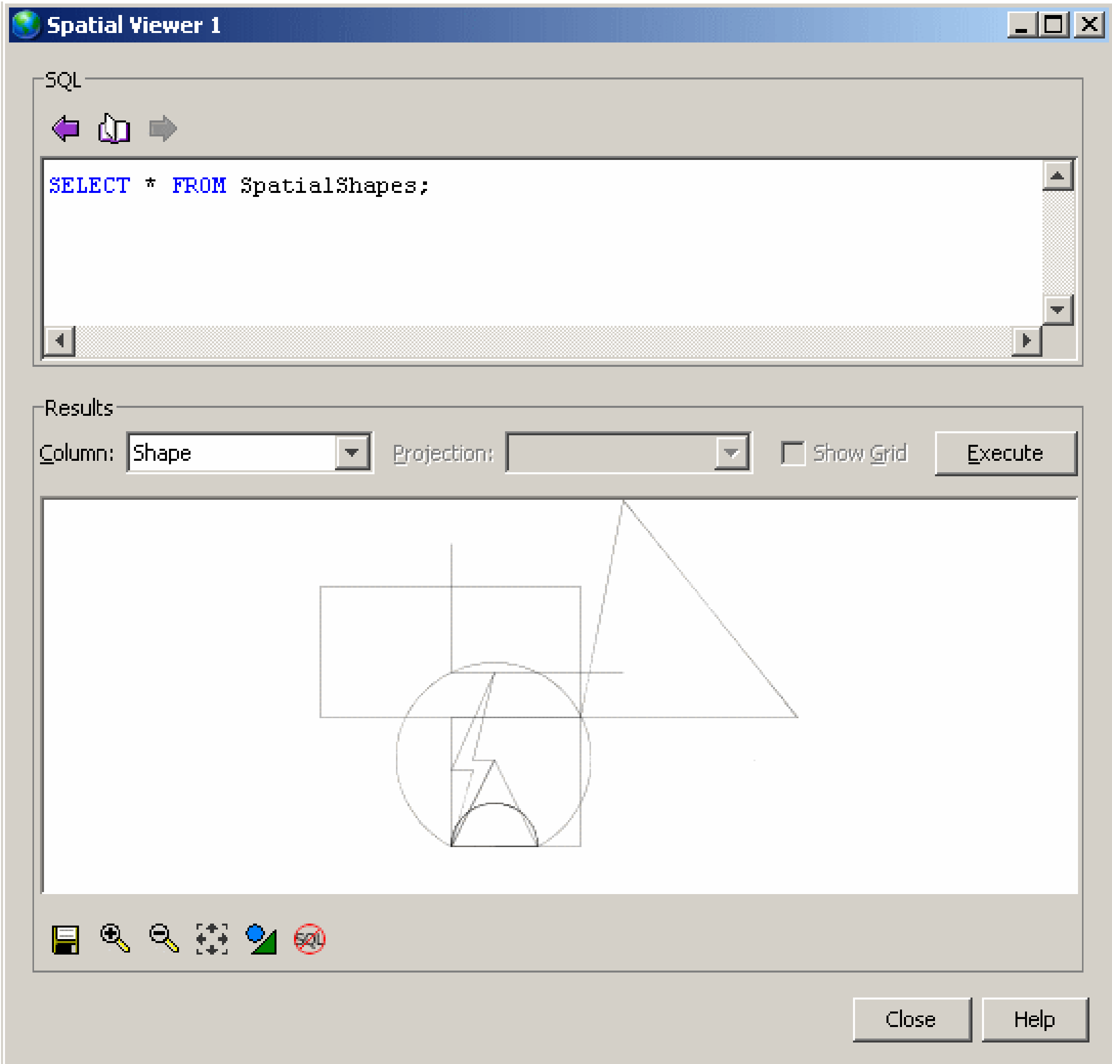
```
SELECT * FROM SpatialShapes;
```

The image displayed in the **Results** area reflects all of the geometries in the result set. This is different from viewing geometries in the **Spatial Preview** tab in Interactive SQL, where you only see a preview of the geometry you selected from the results.

The order of rows in a result matter to how the image appears in the **Spatial Viewer** because the image is drawn in the order in which the rows are processed, with the most recent appearing on the top. This means that shapes that occur later in a result set can obscure ones that occur earlier in the result set.

You can use the **Draw Outlined Polygons** tool to remove the coloring from the polygons in a drawing to reveal the outline of all shapes. This tool is located beneath the image, near the controls for saving, zooming, and panning. Here is an example of how the image appears as outlines:



Load spatial data from a Well Known Text (WKT) file

This section provides you with an overview of loading spatial data from a WKT file.

To load spatial data from a WKT file

1. First you create a file that contains spatial data in WKT format that you will later load into the database as follows:
   a. Open a text editor such as Notepad.
   b. The following snippet contains a group of geometries, defined in WKT. Copy the contents of the snipped to your clipboard and paste it into your text editor:

```
head,"CircularString(1.1 1.9, 1.1 2.5, 1.1 1.9)"
left iris,"Point(0.96 2.32)"
right iris,"Point(1.24 2.32)"
left eye,"MultiCurve(CircularString(0.9 2.32, 0.95 2.3, 1.0
2.32),CircularString(0.9 2.32, 0.95 2.34, 1.0 2.32))"
right eye,"MultiCurve(CircularString(1.2 2.32, 1.25 2.3, 1.3
2.32),CircularString(1.2 2.32, 1.25 2.34, 1.3 2.32))"
nose,"CircularString(1.1 2.16, 1.1 2.24, 1.1 2.16)"
mouth,"CircularString(0.9 2.10, 1.1 2.00, 1.3 2.10)"
hair,"MultiCurve(CircularString(1.1 2.5, 1.0 2.48, 0.8
2.4),CircularString(1.1 2.5, 1.0 2.52, 0.7 2.5),CircularString(1.1 2.5,
1.0 2.56, 0.9 2.6),CircularString(1.1 2.5, 1.05 2.57, 1.0 2.6))"
neck,"LineString(1.1 1.9, 1.1 1.8)"
clothes and box,"MultiSurface(((1.6 1.9, 1.9 1.9, 1.9 2.2, 1.6 2.2, 1.6
1.9)),((1.1 1.8, 0.7 1.2, 1.5 1.2, 1.1 1.8)))"
L,"MultiCurve(CircularString(1.05 1.56, 1.03 1.53, 1.05
1.50),CircularString(1.05 1.50, 1.10 1.48, 1.15
1.52),CircularString(1.15 1.52, 1.14 1.54, 1.12
1.53),CircularString(1.12 1.53, 1.06 1.42, 0.95
1.28),CircularString(0.95 1.28, 0.92 1.31, 0.95
1.34),CircularString(0.95 1.34, 1.06 1.28, 1.17 1.32))"
holes in box,"MultiPoint((1.65 1.95),(1.75 1.95),(1.85 1.95),(1.65
2.05),(1.75 2.05),(1.85 2.05),(1.65 2.15),(1.75 2.15),(1.85 2.15))"
arms and legs,"MultiLineString((0.9 1.2, 0.9 0.8),(1.3 1.2, 1.3 0.8),
(0.97 1.6, 1.6 1.9),(1.23 1.6, 1.7 1.9))"
left cart wheel,"CircularString(2.05 0.8, 2.05 0.9, 2.05 0.8)"
right cart wheel,"CircularString(2.95 0.8, 2.95 0.9, 2.95 0.8)"
cart body,"Polygon((1.9 0.9, 1.9 1.0, 3.1 1.0, 3.1 0.9, 1.9 0.9))"
angular shapes on cart,"MultiPolygon(((2.18 1.0, 2.1 1.2, 2.3 1.4, 2.5
1.2, 2.35 1.0, 2.18 1.0)),((2.3 1.4, 2.57 1.6, 2.7 1.3, 2.3 1.4)))"
round shape on cart,"CurvePolygon(CompoundCurve(CircularString(2.6 1.0,
2.7 1.3, 2.8 1.0),(2.8 1.0, 2.6 1.0)))"
cart handle,"GeometryCollection(MultiCurve((2.0 1.0, 2.1
1.0),CircularString(2.0 1.0, 1.98 1.1, 1.9 1.2),CircularString(2.1 1.0,
2.08 1.1, 2.0 1.2),(1.9 1.2, 1.85 1.3),(2.0 1.2, 1.9 1.35),(1.85 1.3,
1.9 1.35)),CircularString(1.85 1.3, 1.835 1.29, 1.825
1.315),CircularString(1.9 1.35, 1.895 1.38, 1.88
1.365),LineString(1.825 1.315, 1.88 1.365))"
```

c. Save the file as *wktgeometries.csv*.

2. In Interactive SQL, connect to the sample database (demo.db) as user DBA, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.

3. Create a table called SA_WKT and load the data from *wktgeometries.csv* into it as follows. Be sure to replace the path to the *.csv* file with the path where you saved the file:

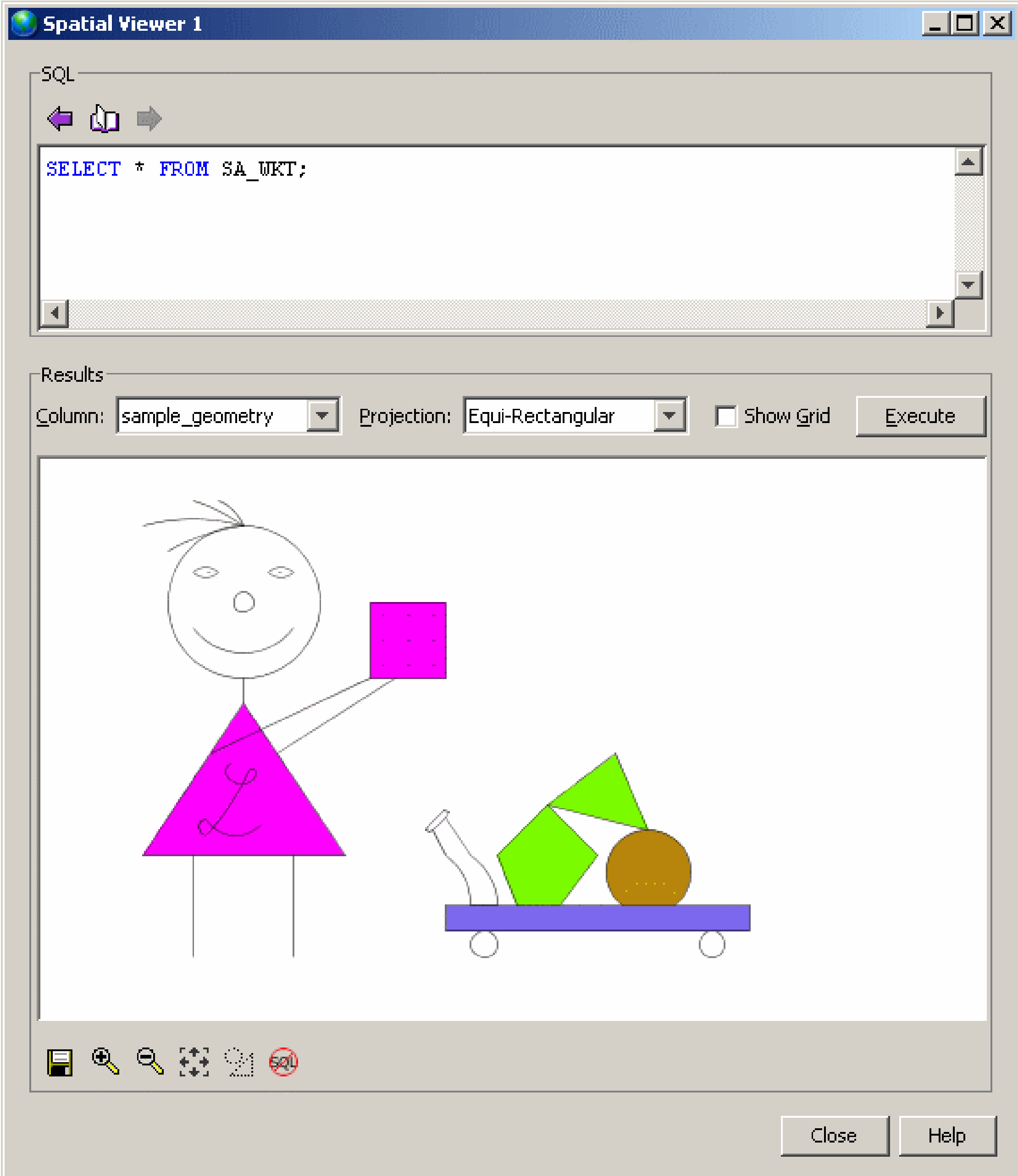
```
DROP TABLE IF EXISTS SA_WKT;
CREATE TABLE SA_WKT (
    description CHAR(24),
    sample_geometry ST_Geometry(SRID=1000004326)
);

LOAD TABLE SA_WKT FROM 'C:\\Documents and Settings\\All Users\\Documents\
\SQL Anywhere 12\\Samples\\wktgeometries.csv' DELIMITED BY ',';
```

The data is loaded into the table.

4. In Interactive SQL, select **Tools** » **Spatial Viewer**.

5. In the **Spatial Viewer**, execute the following command to see the geometries:

```
SELECT * FROM SA_WKT;
```



6. Your data may have several columns of spatial data. In this next example, you create a file of WKT data containing one of each supported spatial data type, stored in individual columns.

   Copy the following code snippet to your text editor and save the file as *wktgeometries2.csv*:

```
"Point(0 0)",,,,,,,,,,,,,,
,"LineString(0 0, 1 1)",,,,,,,,,,,,,
,,"CircularString(0 0, 1 1, 0 0)",,,,,,,,,,,,
,,,"CompoundCurve(CircularString(0 0, 1 1, 1 0),(1 0, 0 1))",,,,,,,,,,,
,,,,"CompoundCurve(CircularString(0 0, 1 1, 1 0),(1 0, 0 1),(0 1, 0
0))",,,,,,,,,,
,,,,,"Polygon((-1 0, 1 0, 2 1, 0 3, -2 1, -1 0))",,,,,,,,,
,,,,,,"CurvePolygon(CompoundCurve(CircularString(0 0, 1 1, 1 0),(1 0, 0
0)))",,,,,,,,
,,,,,,,"CurvePolygon(CompoundCurve(CircularString(0 0, 2 1, 2 0),(2 0, 0
0)))",,,,,,,
,,,,,,,,"MultiPoint((2 0),(0 0),(3 0),(1 0))",,,,,,
,,,,,,,,,"MultiPolygon(((4 0, 4 1, 5 1, 5 0, 4 0)),((-1 0, 1 0, 2 1, 0 3,
-2 1, -1 0)))",,,,,
,,,,,,,,,,"MultiSurface(((4 0, 4 1, 5 1, 5 0, 4
0)),CurvePolygon(CompoundCurve(CircularString(0 0, 2 1, 2 0),(2 0, 0
0))))",,,,
,,,,,,,,,,,"MultiLineString((2 0, 0 0),(3 0, 1 0),(-2 1, 0 4))",,,
,,,,,,,,,,,,"MultiCurve((3 2, 4 3),CircularString(0 0, 1 1, 0 0))",,
,,,,,,,,,,,,,"GeometryCollection(MultiPoint((2 0),(0 0),(3 0),(1
0)),MultiSurface(((4 0, 4 1, 5 1, 5 0, 4
0)),CurvePolygon(CompoundCurve(CircularString(0 0, 2 1, 2 0),(2 0, 0
0)))),MultiCurve((3 2, 4 3),CircularString(0 0, 1 1, 0 0)))",
,,,,,,,,,,,,,,"GeometryCollection(Point(0
0),CompoundCurve(CircularString(0 0, 1 1, 1 0),(1 0, 0 1),(0 1, 0
0)),CurvePolygon(CompoundCurve(CircularString(0 0, 2 1, 2 0),(2 0, 0
0))),MultiPoint((2 0),(0 0),(3 0),(1 0)),MultiSurface(((4 0, 4 1, 5 1, 5
0, 4 0)),CurvePolygon(CompoundCurve(CircularString(0 0, 2 1, 2 0),(2 0, 0
0)))),MultiCurve((3 2, 4 3),CircularString(0 0, 1 1, 0 0)))"
```

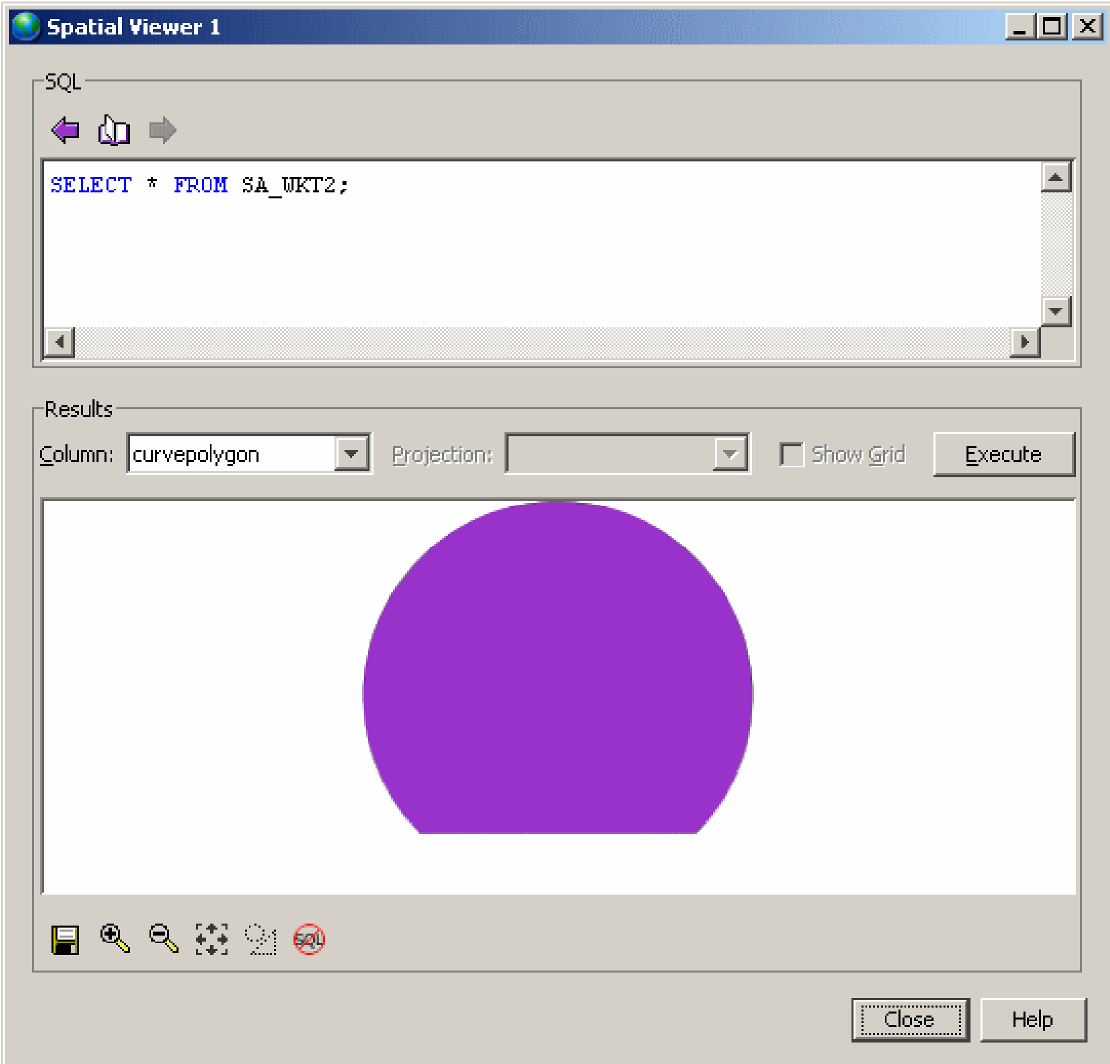
7. Create a table called SA_WKT2 and load the data from *wktgeometries2.csv* into it as follows. Be sure to replace the path to the *csv* file with the path where you saved the file:

```
DROP TABLE IF EXISTS SA_WKT2;
CREATE TABLE SA_WKT2 (
    point          ST_Point,
    line           ST_LineString,
    circle         ST_CircularString,
    compoundcurve  ST_CompoundCurve,
    curve          ST_Curve,
    polygon1       ST_Polygon,
    curvepolygon   ST_CurvePolygon,
    surface        ST_Surface,
    multipoint     ST_MultiPoint,
    multipolygon   ST_MultiPolygon,
    multisurface   ST_MultiSurface,
    multiline      ST_MultiLineString,
    multicurve     ST_MultiCurve,
    geomcollection ST_GeomCollection,
    geometry       ST_Geometry
);

LOAD TABLE SA_WKT2 FROM 'C:\\Documents and Settings\\All Users\\Documents\
\SQL Anywhere 12\\Samples\\wktgeometries2.csv' DELIMITED BY ',';
```

The data is loaded into the table.

8. In the **Spatial Viewer**, execute the following command to see the geometries.

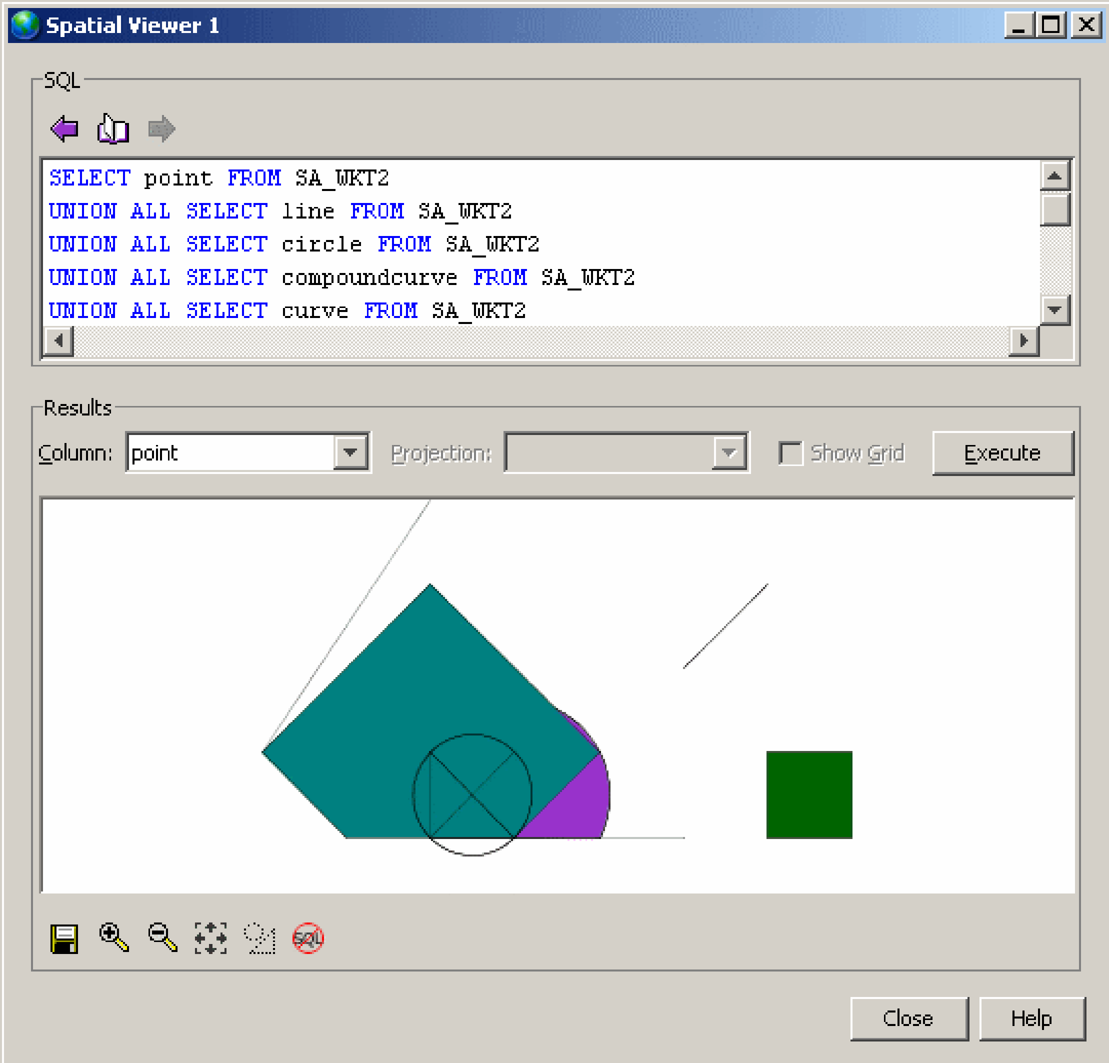
Note that you can only see one column of data at a time; you must use the **Column** dropdown in the **Results** area to view the geometries for the other columns. For example, this is the view of the geometry in the curvepolygon column:



9. To view the geometries from all of the columns at once, you can execute a SELECT statement for each column and UNION ALL the results, as follows:

```
SELECT point FROM SA_WKT2
UNION ALL SELECT line FROM SA_WKT2
UNION ALL SELECT circle FROM SA_WKT2
UNION ALL SELECT compoundcurve FROM SA_WKT2
UNION ALL SELECT curve FROM SA_WKT2
UNION ALL SELECT polygon1 FROM SA_WKT2
UNION ALL SELECT curvepolygon FROM SA_WKT2
UNION ALL SELECT surface FROM SA_WKT2
UNION ALL SELECT multipoint FROM SA_WKT2
UNION ALL SELECT multipolygon FROM SA_WKT2
UNION ALL SELECT multisurface FROM SA_WKT2
UNION ALL SELECT multiline FROM SA_WKT2
UNION ALL SELECT multicurve FROM SA_WKT2
```

```
UNION ALL SELECT geomcollection FROM SA_WKT2
UNION ALL SELECT geometry FROM SA_WKT2
```



Geometry interiors, exteriors, and boundaries

The **interior** of a geometry is all points that are part of the geometry except the boundary.

The **exterior** of a geometry is all points that are not part of the geometry. This can include the space inside an interior ring, for example in the case of a polygon with a hole. Similarly, the space both inside and outside a linestring ring is considered the exterior.

The **boundary** of a geometry is what is returned by the ST_Boundary method.

Knowing the boundary of a geometry helps when comparing to another geometry to determine how the two geometries are related. However, while all geometries have an interior and an exterior, not all geometries have a boundary, nor are their boundaries always intuitive.

Here are some cases of geometries where the boundary may not be intuitive:

- **Point** A point (such as A) has no boundary.
- **Lines and curves** The boundary for lines and curves (B, C, D, E, F) are their endpoints. Geometries B, C, and E have two end points for a boundary. Geometry D has four end points for a boundary, and geometry F has four.
- **Polygon** The boundary for a polygon (such as G) is its outer ring and any inner rings.
- **Rings** A ring—a curve where the start point is the same as the end point and there are no self-intersections (such as H)—has no boundary.

See also

- "ST_Boundary method for type ST_Geometry" on page 134

Additional information on the ST_Dimension method

As well as having distinct properties of its own, each of the geometry sub-classes inherits properties from the ST_Geometry supertype. A geometry subtype has one of the following dimensional values:

- **-1** A value of -1 indicates that the geometry is empty (it does not contain any points).
- **0** A value of 0 indicates the geometry has no length or area. The subtypes ST_Point and ST_MultiPoint have dimensional values of 0. A point represents a geometric feature that can be represented by a single pair of coordinates, and a cluster of unconnected points represents a multipoint feature.
- **1** A value of 1 indicates the geometry has length but no area. The set of subtypes that have a dimension of 1 are subtypes of ST_Curve (ST_LineString, ST_CircularString, and ST_CompoundCurve), or collection types containing these types, but no surfaces. In GIS data, these geometries of dimension 1 are used to define linear features such as streams, branching river systems, and road segments.
- **2** A value of 2 indicates the geometry has area. The set of subtypes that have a dimension of 2 are subtypes of ST_Surface (ST_Polygon and ST_CurvePolygon), or collection types containing these

types. Polygons and multipolygons represent geometric features with perimeters that enclose a defined area such as lakes or parks.

Note
A single ST_GeomCollection can contain geometries of different dimensions, and the highest dimension geometry is returned

Test custom relationships using the ST_Relate method

For best performance, you should always use methods like ST_Within, or ST_Touches to test single, specific relationships between geometries. However, if you have more than one relationship to test, ST_Relate can be a better method, since you can test for several relationships at once. ST_Relate is also good when you want to test for a different interpretation of a predicate such as within (ST_Within). For example, when testing if a point is within another geometry, ST_Within returns false if the point falls on the boundary of the other geometry. The interpretation of within you want to test for, however, may include having a point on a boundary. In this case, you perform a custom relationship test using ST_Relate to test for the condition.

The most common use of ST_Relate is as a predicate, where you specify the exact relationship(s) to test for. However, you can also use ST_Relate to determine all possible relationships between two geometries.

Predicate use of ST_Relate

ST_Relate assesses how geometries are related by performing **intersection tests** of their interiors, boundaries, and exteriors. The relationship between the geometries is then described in a 9-character string in DE-9IM (Dimensionally Extended 9 Intersection Model) format, where each character of the string represents the result of an intersection test.

When you use ST_Relate as a predicate, you pass a DE-9IM string reflecting intersection results to test for. If the geometries satisfy the conditions in the DE-9IM string you specified, then ST_Relate returns a **1**. If the conditions are not satisfied, then **0** is returned. If either or both of the geometries is NULL, then **NULL** is returned.

The 9-character DE-9IM string is a flattened representation of a pair-wise matrix of the intersection tests between interiors, boundaries, and exteriors. The next table shows the 9 intersection tests in the order they are performed: left to right, top to bottom:

	g2 interior	g2 boundary	g2 exterior
g1 interior	`Interior(g1) ∩ Interior(g2)`	`Interior(g1) ∩ Boundary(g2)`	`Interior(g1) ∩ Exterior(g2)`
g1 boundary	`Boundary(g1) ∩ Interior(g2)`	`Boundary(g1) ∩ Boundary(g2)`	`Boundary(g1) ∩ Exterior(g2)`

g1 exterior	`Exterior(g1) ∩ Interior(g2)`	`Exterior(g1) ∩ Boundary(g2)`	`Exterior(g1) ∩ Exterior(g2)`

When you specify the DE-9IM string, you can specify *, 0, 1, 2, T, or F for any of the 9 characters. These values refer to the number of dimensions of the geometry created by the intersection.

When you specify:	The intersection test result must return:
T	one of: 0, 1, 2 (an intersection of any dimension)
F	-1
*	-1, 0, 1, 2 (any value)
0	0
1	1
2	2

Suppose you want to test whether a geometry is *within* another geometry using ST_Relate and a custom DE-9IM string for the within predicate:

```
SELECT new ST_Polygon('Polygon(( 2 3, 8 3, 4 8, 2 3 ))').ST_Relate( new
ST_Polygon('Polygon((-3 3, 3 3, 3 6, -3 6, -3 3))'), 'T*F**F***' );
```

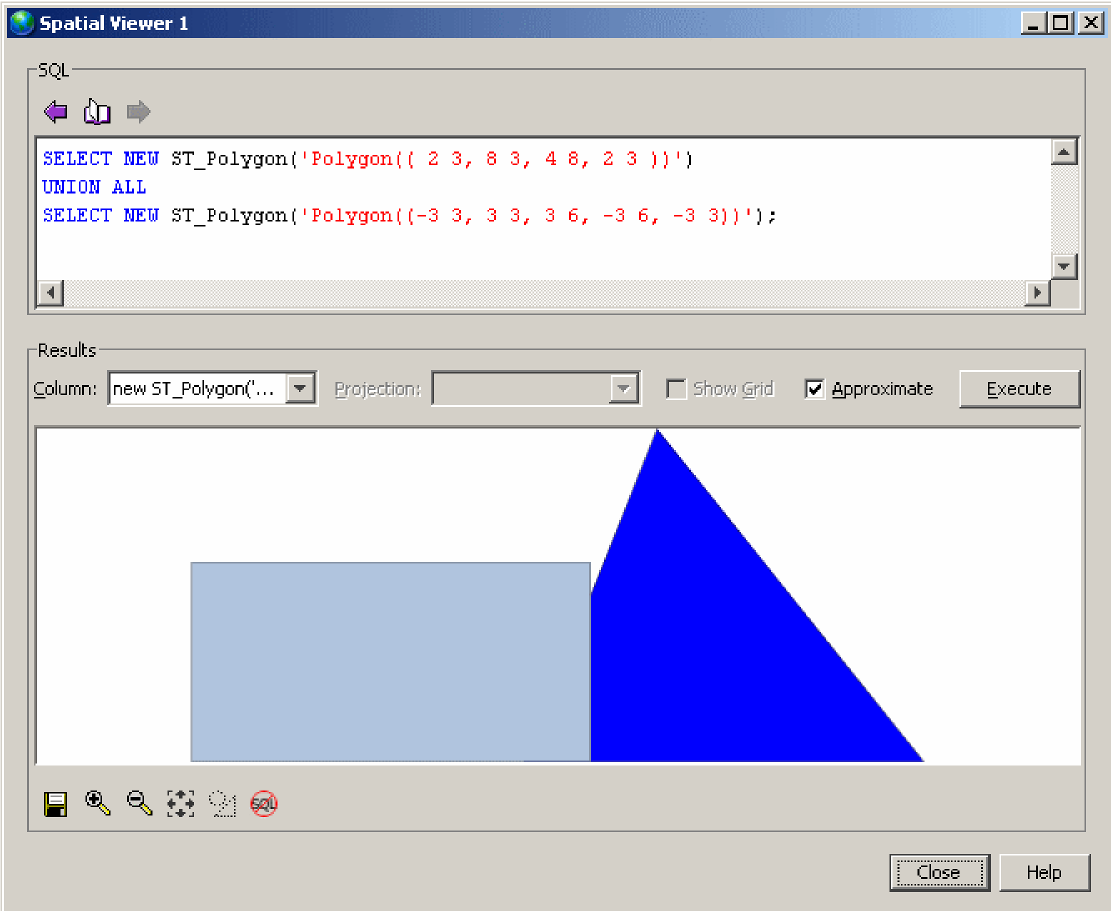
This is equivalent to asking ST_Relate to look for the following conditions when performing the intersection tests:

	g2 interior	g2 boundary	g2 exterior
g1 interior	**one of: 0, 1, 2**	one of: 0, 1, 2, -1	**-1**
g1 boundary	one of: 0, 1, 2, -1	one of: 0, 1, 2, -1	**-1**
g1 exterior	one of: 0, 1, 2, -1	one of: 0, 1, 2, -1	one of: 0, 1, 2, -1

When you execute the query, however, ST_Relate returns 0 indicating that the first geometry is not within the second geometry.

To view the two geometries and compare their appearance to what is being tested, execute the following statement in the Interactive SQL Spatial Viewer (**Tools** » **Spatial Viewer**):

```
SELECT NEW ST_Polygon('Polygon(( 2 3, 8 3, 4 8, 2 3 ))')
UNION ALL
SELECT NEW ST_Polygon('Polygon((-3 3, 3 3, 3 6, -3 6, -3 3))');
```

See also: "ST_Relate(ST_Geometry,CHAR(9)) method for type ST_Geometry" on page 182

Non-predicate use of ST_Relate

The non-predicate use of ST_Relate returns the full relationship between two geometries.

For example, suppose you have the same two geometries used in the previous example and you want to know how they are related. You would execute the following statement in Interactive SQL to return the DE-9IM string defining their relationship.

```
SELECT new ST_Polygon('Polygon(( 2 3, 8 3, 4 8, 2 3 ))').ST_Relate(new
ST_Polygon('Polygon((-3 3, 3 3, 3 6, -3 6, -3 3))'));
```

ST_Relate returns the DE-9IM string, `212111212`.

The matrix view of this value shows that there are many points of intersection:

	g2 interior	g2 boundary	g2 exterior

g1 interior	2	1	2
g1 boundary	1	1	1
g1 exterior	2	1	2

See also: “ST_Relate(ST_Geometry) method for type ST_Geometry” on page 183

See also

- “ST_Intersects method for type ST_Geometry” on page 165
- “ST_Overlaps method for type ST_Geometry” on page 180
- “ST_Within method for type ST_Geometry” on page 211
- “ST_Disjoint method for type ST_Geometry” on page 150
- “ST_Touches method for type ST_Geometry” on page 207
- “ST_Crosses method for type ST_Geometry” on page 146
- “ST_Contains method for type ST_Geometry” on page 135
- “ST_Relate method for type ST_Geometry” on page 181

Tutorial: Experimenting with the spatial features

This tutorial shows allows you to experiment with some of the spatial features in SQL Anywhere. To do so, you will first load an ESRI shapefile into your sample database (demo.db) to give you some valid spatial data to experiment with.

The tutorial is broken into the following parts:

- “Part 1: Install additional units of measure and spatial reference systems” on page 47
- “Part 2: Download the ESRI shapefile data” on page 48
- “Part 3: Load the ESRI shapefile data” on page 49
- “Part 4: Query spatial data” on page 52
- “Part 5: Output spatial data to SVG” on page 54
- “Part 6: Project spatial data” on page 56
- “(optional) Restore the sample database (demo.db)” on page 58

Part 1: Install additional units of measure and spatial reference systems

This part of the tutorial shows you how to use the sa_install_feature system procedure to install many predefined units of measure and spatial reference systems you will need later in this tutorial.

To install the predefined units of measure and spatial reference systems

1. Using Interactive SQL, start and connect to the sample database (demo.db) as user DBA, or as a member of the SYS_SPATIAL_ADMIN_ROLE group.

   The sample database is located in your */samples* directory. For the default location of your */samples* directory, see "SQLANYSAMP12 environment variable" [*SQL Anywhere Server - Database Administration*].

2. Execute the following statement:

   ```
   CALL sa_install_feature( 'st_geometry_predefined_srs' );
   ```

   When the statement finishes, the additional units of measure and spatial reference systems have been installed.

   See also: "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*] and "CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

3. To determine the units of measure installed in your database, you can execute the following query:

   ```
   SELECT * FROM SYSUNITOFMEASURE;
   ```

   See also: "SYSUNITOFMEASURE system view" [*SQL Anywhere Server - SQL Reference*].

4. To determine the spatial reference systems installed in your database, you can look in the **Spatial Reference Systems** folder in Sybase Central, or execute the following query:

   ```
   SELECT * FROM SYSSPATIALREFERENCESYSTEM;
   ```

   See also: "SYSSPATIALREFERENCESYSTEM system view" [*SQL Anywhere Server - SQL Reference*].

Part 2: Download the ESRI shapefile data

In this part of the tutorial, you will download an ESRI shapefile from the US Census website (www2.census.gov). The shapefile you download represents the Massachusetts 5-digit code zip code information used during the 2002 census tabulation. Each zip code area is treated as either a polygon or multipolygon.

To download sample spatial data

1. Create a local directory called *c:\temp\massdata*.

2. Go to the following URL: http://www2.census.gov/cgi-bin/shapefiles2009/national-files

3. On the right-hand side of the page, in the **State- and County-based Shapefiles** dropdown, select **Massachusetts**, and then click **Submit**.

4. On the left-hand side of the page, select **5-Digit ZIP Code Tabulation Area (2002)**, and then click **Download Selected Files**.

5. When prompted, save the zip file, *multiple_tiger_files.zip*, to *c:\temp\massdata*, and extract its contents. This creates a subdirectory called 25_MASSACHUSETTS containing another zip file called *tl_2009_25_zcta5.zip*.

6. Extract the contents of *tl_2009_25_zcta5.zip* to *C:\temp\massdata*.

   This unpacks five files, including an ESRI shape file (*.shp*) you will use to load the spatial data into the database.

Part 3: Load the ESRI shapefile data

This part of the tutorial shows you how to find out the columns in the ESRI shapefile and use that information to create a table that you will load the data into.

To load the spatial data from the ESRI shapefile into the database

1. Since spatial data is associated with a specific spatial reference system, when you load data into the database, you must load it into the same spatial reference system, or at least one with an equivalent definition. To find out the spatial reference system information for the ESRI shapefile, open the project file, *c:\temp\massdata\tl_2009_25_zcta5.prj*, in a text editor. This file contains the spatial reference system information you need.

   ```
   GEOGCS["GCS_North_American_1983",DATUM["D_North_American_1983",
   SPHEROID["GRS_1980",6378137,298.257222101]],PRIMEM["Greenwich",
   0],UNIT["Degree",0.0174532925199433]]
   ```

   The string **GCS_North_American_1983** is the name of the spatial reference system associated with the data.

2. A quick query of the SYSSPATIALREFERENCESYSTEM view, `SELECT * FROM SYSSPATIALREFERENCESYSTEM WHERE srs_name='GCS_North_American_1983';`, reveals that this name is not present in the list of predefined SRSs. However, you can query for a spatial reference system with the same definition and use it instead:

   ```
   SELECT *
   FROM SYSSPATIALREFERENCESYSTEM
   WHERE definition LIKE '%1983%'
   AND definition LIKE 'GEOGCS%';
   ```

   The query returns a single spatial reference system, NAD83 with SRID **4269**, that has the same definition and will be suitable for loading the data into.

3. Next, you need to create a table to load the spatial data into. To do this, you must first determine the columns in your ESRI shapefile. The following statement returns a description of the columns. It also adds some formatting to the output that will help prepare the result set for inclusion in a CREATE TABLE statement. Note the use of the SRID you found in the previous step when calling the sa_describe_shapefile system procedure:

   ```
   SELECT name || ' ' || domain_name_with_size || ', '
   FROM sa_describe_shapefile('C:\temp\massdata\tl_2009_25_zcta5.shp', 4269)
   ORDER BY column_number;
   ```

4. Select all rows in the result set, then right-click and select **Copy Data** » **Cells**.

5. In the top pane in Interactive SQL, remove the SELECT statement you executed and type **CREATE TABLE Massdata(**, and then paste the cells you copied.

6. Change the definition for the record_number column to be a **PRIMARY KEY** (that is, change `record_number int,` to `record_number int PRIMARY KEY,`).

7. Change column name ZCTA5CE to be **ZIP**.

8. For the last column in the list, remove the trailing comma and add a closing bracket followed by a semicolon.

   Your CREATE TABLE statement should look as follows:

   ```
   CREATE TABLE Massdata(
   record_number int PRIMARY KEY,
   geometry ST_Geometry(SRID=4269),
   ZIP varchar(5),
   CLASSFP varchar(2),
   MTFCC varchar(5),
   FUNCSTAT varchar(1),
   ALAND bigint,
   AWATER bigint,
   INTPTLAT varchar(11),
   INTPTLON varchar(12)
   );
   ```

9. Execute the CREATE TABLE statement to create the table.

10. Load the spatial data in the ESRI shapefile into Massdata using the following statement. This may take several minutes to complete.

    ```
    LOAD TABLE Massdata
    USING FILE 'C:\temp\massdata\tl_2009_25_zcta5.shp'
    FORMAT SHAPEFILE;
    ```

11. In the Massdata table, the two columns INTPTLON and INTPTLAT represent the X and Y coordinates for the center of the zip code region. In this step, you combine the values into an ST_Point column called CenterPoint. Each value in the CenterPoint column (in WKT) is the center point of the zip code region represented in the geometry column. This column will be useful in some of the tutorial examples later on.

    To create the column, execute the following statement:

    ```
    ALTER TABLE Massdata
    ADD CenterPoint AS ST_Point(SRID=4269)
    COMPUTE( new ST_Point( CAST( INTPTLON AS DOUBLE ), CAST( INTPTLAT AS
    DOUBLE ), 4269 ) );
    ```

12. You can view the data by executing the following statement in Interactive SQL:

    ```
    SELECT * FROM Massdata;
    ```

    Each row in the results represents a zip code region. Massdata.geometry holds the shape information of the zip code region as either a polygon (one area) or multipolygon (two or more incontiguous areas).

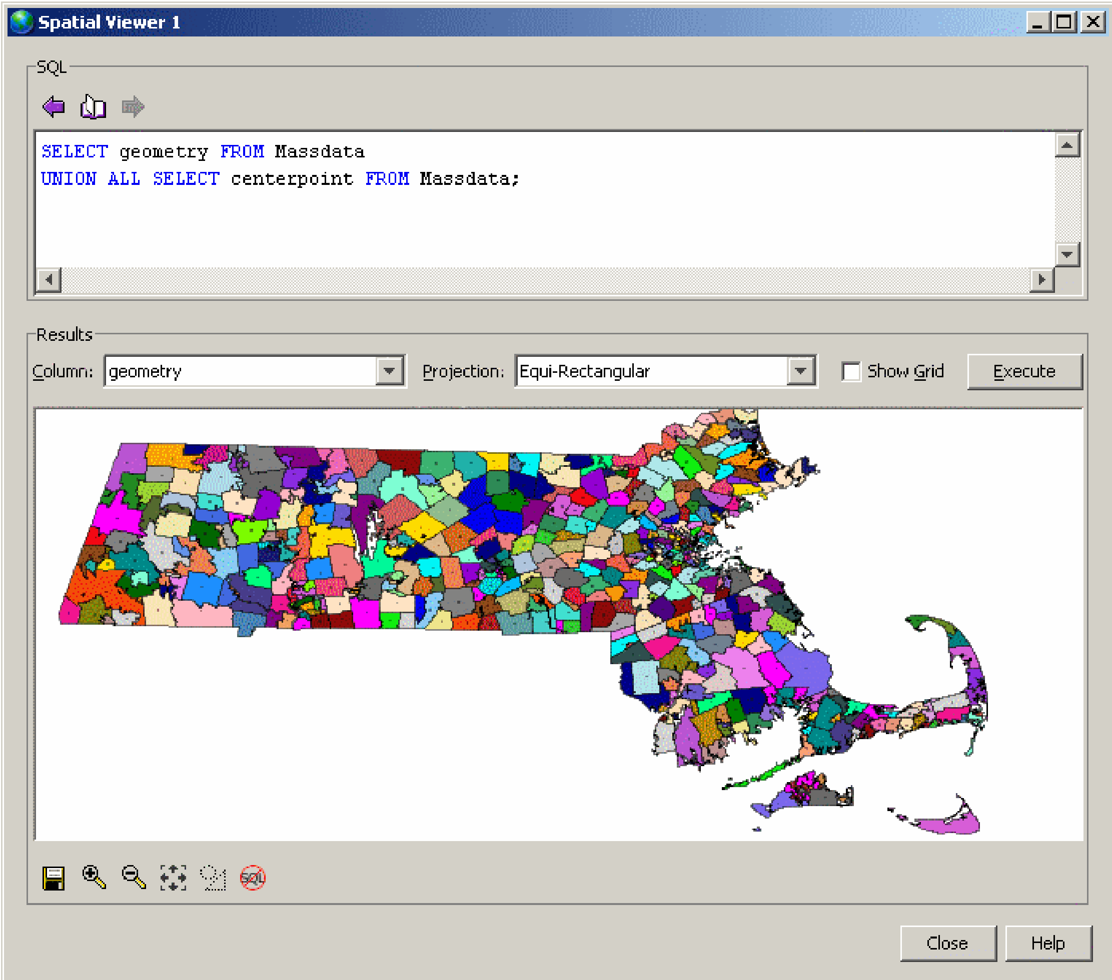
13. To view an individual geometry (a zip code region) as a shape, double-click any value in Massdata.geometry and click the **Spatial Preview** tab of the **Value Of Column** window.

    If you receive an error saying the value is to large, or suggesting you include a primary key in the results, it is because the value has been truncated for display purposes in Interactive SQL. To fix this, you can either modify the query to include the primary key column in the results, or adjust the **Truncation Length** setting for Interactive SQL. Changing the setting is recommended if you don't want to have to include the primary key each time you query for geometries with the intent to view them in Interactive SQL.

    To change the **Truncation Length** setting for Interactive SQL, click **Tools** » **Options** » **SQL Anywhere**, set **Truncation Length** to a high number such as 100000.

14. To view the entire data set as one shape, click **Tools** » **Spatial Viewer** to open the SQL Anywhere **Spatial Viewer** and execute the following query:

```
SELECT geometry FROM Massdata
UNION ALL SELECT centerpoint FROM Massdata;
```



Part 4: Query spatial data

This part of the tutorial shows you how to use some of the spatial methods to query the data in a meaningful context.

The queries are performed on one or both of the SpatialContacts table, which holds names and contact information for people--many of whom live in Massachusetts, and on the Massdata table you created. You will also learn how to calculate distances, which requires you to add units of measurement to your database.

To query the spatial data

1. In the following steps, you will work with the zip code area 01775.

   Create a variable named `@Mass_01775` to hold the associated geometry.

   ```
   CREATE VARIABLE @Mass_01775 ST_Geometry;
   SELECT geometry INTO @Mass_01775
   ```



```
FROM Massdata
WHERE ZIP = '01775';
```

2. Suppose you want to find all contacts in SpatialContacts in the zip code area 01775 and surrounding zip code areas. For this, you can use the ST_Intersects method, which returns geometries that intersects with, or are the same as, the specified geometry. You would execute the following statement:

   ```
   SELECT c.Surname, c.GivenName, c.Street, c.City, c.PostalCode, z.geometry
   FROM Massdata z, SpatialContacts c
   WHERE
   c.PostalCode = z.ZIP
   AND z.geometry.ST_Intersects( @Mass_01775 ) = 1;
   ```

   See also: "ST_Intersects method for type ST_Geometry" on page 165

3. All rows in Massdata.geometry are associated with the same spatial reference system (SRID 4269) because you assigned SRID 4269 when you created the geometry column and loaded data into it.

   However, it is also possible to create an **undeclared** ST_Geometry column (that is, without assigning a SRID to it). This may be necessary if you intend store spatial values that have different SRSs associated to them in a single column. When operations are performed on these values, the spatial reference system associated with each value is used.

   One danger of having an undeclared column, is that the database server does not prevent you from changing an spatial reference system that is associated with data in an undeclared column.

   If the column has a declared SRID, however, the database server does not allow you to modify the spatial reference system associated with the data. You must first unload and then truncate the data in the declared column, change the spatial reference system, and then reload the data.

   You can use the ST_SRID method to determine the SRID associated with values in a column, regardless of whether it is declared or not. For example, the following statement shows the SRID assigned to each row in the Massdata.geometry column:

   ```
   SELECT geometry.ST_SRID()
   FROM Massdata;
   ```

   See also: "ST_SRID method for type ST_Geometry" on page 185

4. You can use the ST_CoveredBy method to check that a geometry is completely contained within another geometry. For example, Massdata.CenterPoint (ST_Point type) contains the latitude/longitude coordinates of the center of the zipcode area, while Massdata.geometry contains the polygon reflecting the zip code area. You can do a quick check to make sure that no CenterPoint value has been set outside its zip code area by executing the following query:

   ```
   SELECT * FROM Massdata
   WHERE NOT(CenterPoint.ST_CoveredBy(geometry) = 1);
   ```

   No rows are returned, indicating that all CenterPoint values are contained within their associated geometries in Massdata.geometry. This check does not validate that they are the true center, of course. You would need to project the data to a flat-Earth spatial reference system and check the CenterPoint values using the ST_Centroid method. For information on how to project data to another spatial reference system, see "Part 6: Project spatial data" on page 56.

See also: "ST_CoveredBy method for type ST_Geometry" on page 142

5. You can use the ST_Distance method to measure the distance between the center point of the zip code areas. For example, suppose you want the list of zip code within 100 miles of zip code area 01775. You could execute the following query:

```
SELECT c.PostalCode, c.City,
       z.CenterPoint.ST_Distance( ( SELECT CenterPoint
                              FROM Massdata WHERE ZIP = '01775' ),
                            'Statute mile' ) dist,
       z.CenterPoint
FROM Massdata z, SpatialContacts c
WHERE c.PostalCode = z.ZIP
  AND dist <= 100
ORDER BY dist;
```

See also: "ST_Distance method for type ST_Geometry" on page 151

6. If knowing the exact distance is not important, you could construct the query using the ST_WithinDistance method instead, which can offer better performance for certain datasets (in particular, for large geometries):

```
SELECT c.PostalCode, c.City, z.CenterPoint
FROM Massdata z, SpatialContacts c
WHERE c.PostalCode = z.ZIP
  AND z.CenterPoint.ST_WithinDistance( ( SELECT CenterPoint
                              FROM Massdata WHERE ZIP = '01775' ),
                            100, 'Statute mile' ) = 1
ORDER BY c.PostalCode;
```

See also: "ST_WithinDistance method for type ST_Geometry" on page 212.

Part 5: Output spatial data to SVG

You can export geometries to SVG format for viewing in Interactive SQL or in an SVG-compatible application. In the following procedure, you create an SVG document to view a multipolygon expressed in WKT.

Output a geometry as SVG for viewing

1. In Interactive SQL, execute the following statement to create a variable with an example geometry:

```
CREATE OR REPLACE VARIABLE @svg_geom
ST_Polygon = (NEW ST_Polygon('Polygon ((1 1, 5 1, 5 5, 1 5, 1 1), (2 2, 2
3, 3 3, 3 2, 2 2))'));
```

2. In Interactive SQL, execute the following SELECT statement to call the ST_AsSVG method:

```
SELECT @svg_geom.ST_AsSVG() AS svg;
```

The result set has a single row that is an SVG image. You can view the image using the **SVG Preview** feature in Interactive SQL. To do this, double-click the result row, and select the **SVG Preview** tab.

If you receive an error saying that the full value could not be read from the database, you need to change the **Truncation Length** setting for Interactive SQL. To do this, in Interactive SQL click **Tools** »

Options » **SQL Anywhere**, and set **Truncation Length** to a high number such as 100000. Execute your query again and view the geometry.

3. The previous step described how to preview an SVG image within Interactive SQL. However, it may be more useful to write the resulting SVG to a file so that it can be read by an external application. You could use the xp_write_file system procedure or the WRITE_CLIENT_FILE function [String] to write to a file relative to either the database server or the client computer. In this example, you will use the OUTPUT statement [Interactive SQL].

   In Interactive SQL, execute the following SELECT statement to call the ST_AsSVG method and output the geometry to a file named *myPolygon.svg*:

   ```
   SELECT @svg_geom.ST_AsSVG();
   OUTPUT TO 'c:\\myPolygon.svg'
   QUOTE ''
   ESCAPES OFF
   FORMAT TEXT
   ```

   You must include the `QUOTE ''` and `ESCAPES OFF`clauses, otherwise line return characters and single quotes are inserted in the XML to preserve whitespace, causing the output to be an invalid SVG file.

4. Open the SVG in a web browser or application that supports viewing SVG images. Alternatively, you can open the SVG in a text editor to view the XML for the geometry.

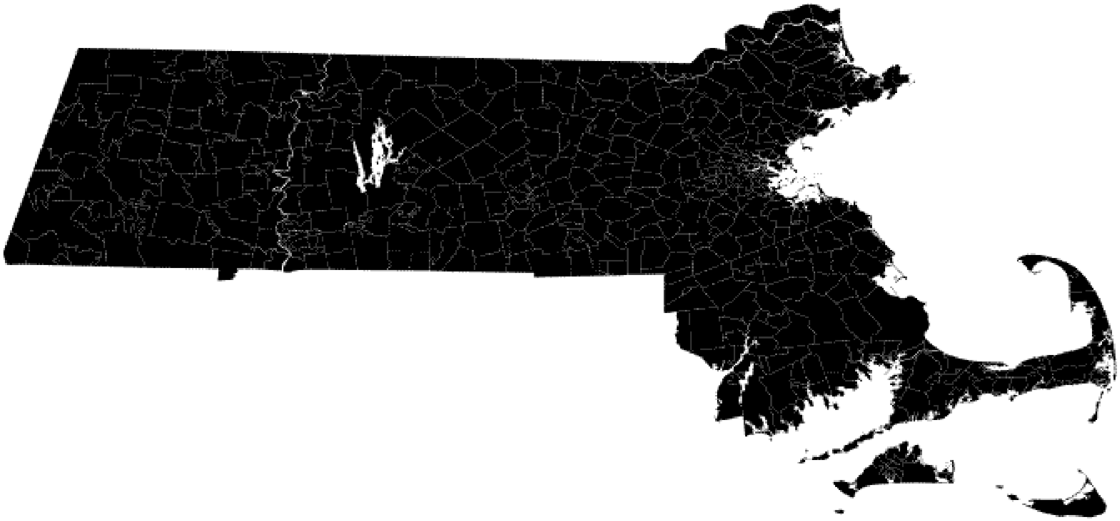
5. The ST_AsSVG method generates an SVG image from a single geometry. In some cases, you want to generate an SVG image including all of the shapes in a group. The ST_AsSVGAggr method is an aggregate function that combines multiple geometries into a single SVG image. First, create a variable to hold the SVG image and generate it using the ST_AsSVGAggr method.

   ```
   CREATE OR REPLACE VARIABLE @svg XML;
   SELECT ST_Geometry::ST_AsSVGAggr( geometry, 'attribute=fill="black"' )
   INTO @svg
   FROM Massdata;
   ```

   The `@svg` variable now holds an SVG image representing all of the zip code regions in the Massdata table. The `'attribute=fill="black"'` specifies the fill color that is used for the generated image. If not specified, the database server chooses a random fill color. Now that you have a variable containing the SVG image you are interested in, you can write it to a file for viewing by other applications. Execute the following statement to write the SVG image to a file relative to the database server.

   ```
   CALL xp_write_file( 'c:\\temp\\Massdata.svg', @svg );
   ```

   The WRITE_CLIENT_FILE function could also be used to write a file relative to the client application, but additional steps may be required to ensure appropriate permissions are enabled. If you open the SVG image in an application that supports SVG data, you should see an image like the following:



You will notice that the image is not uniformly black; there are small gaps between the borders of adjacent zip code regions. These are actually white lines between the geometries and is characteristic of the way the SVG is rendered. There are not really any gaps in the data. Larger white lines are rivers and lakes.

See also:

- “OUTPUT statement [Interactive SQL]” [*SQL Anywhere Server - SQL Reference*]
- “ST_AsSVG method for type ST_Geometry” on page 104
- “ST_AsSVGAggr method for type ST_Geometry” on page 107
- “xp_write_file system procedure” [*SQL Anywhere Server - SQL Reference*]
- “WRITE_CLIENT_FILE function [String]” [*SQL Anywhere Server - SQL Reference*]

Part 6: Project spatial data

This part of the tutorial shows you how to project data into an spatial reference system that uses the flat-Earth model so that you can calculate area and distance measurements.

The spatial values in Massdata were assigned SRID 4269 (NAD83 spatial reference system) when you loaded the data into the database from the ESRI shapefile. SRID 4269 is a round-Earth spatial reference system. However, calculations such as the area of geometries and some spatial predicates are not supported in the round-Earth model. If your data is currently associated with a round-Earth spatial reference system, you can create a new spatial column that projects the values into a flat-Earth spatial reference system, and then perform your calculations on that column.

To project data

1. To measure the area of polygons representing the zip code areas, you must project the data in Massdata.geometry to a flat-Earth spatial reference system.

   To select an appropriate SRID to project the data in Massdata.geometry into, query the SYSSPATIALREFERENCESYSTEM system view for a SRID containing the word Massachusetts, as follows:


```
SELECT * FROM SYSSPATIALREFERENCESYSTEM WHERE srs_name LIKE '%massachusetts
%';
```

This returns several SRIDs suitable for use with the Massachusetts data. For the purpose of this tutorial, **3586** will be used.

2. You must now create a column, Massdata.geometry_flat, into which you will project the geometries into 3586 using the ST_Transform method:

```
ALTER TABLE Massdata
ADD proj_geometry
 AS ST_Geometry(SRID=3586)
 COMPUTE( geometry.ST_Transform( 3586 ) );
```

See also: "ST_Transform method for type ST_Geometry" on page 208

3. You can compute the area using the Massdata.proj_geometry. For example, execute the following statement:

```
SELECT zip, proj_geometry.ST_ToMultiPolygon().ST_Area('Statute Mile') AS
area
FROM Massdata
ORDER BY area DESC;
```

> **Note**
> ST_Area is not supported on round-Earth spatial reference systems and ST_Distance is supported but only between point geometries.

4. To see the impact that projecting to another spatial reference system has on calculations of distance, you can use the following query to compute the distance between the center points of the zip codes using the round-Earth model (more precise) or the projected flat-Earth model. Both models agree fairly well for this data because the projection selected is suitable for the data set.

```
SELECT M1.zip, M2.zip,
       M1.CenterPoint.ST_Distance( M2.CenterPoint, 'Statute Mile' )
dist_round_earth,

M1.CenterPoint.ST_Transform( 3586 ).ST_Distance( M2.CenterPoint.ST_Transfo
rm( 3586 ), 'Statute Mile' ) dist_flat_earth
FROM Massdata M1, Massdata M2
WHERE M1.ZIP = '01775'
ORDER BY dist_round_earth DESC;
```

5. Suppose you want to find neighboring zip code areas that border the zip code area 01775. To do this, you would use the ST_Touches method. The ST_Touches method compares geometries to see if one geometry touches another geometry without overlapping in any way. Note that the results for ST_Touches do not include the row for zip code 01775 (unlike the ST_Intersects method).

```
DROP VARIABLE @Mass_01775;
CREATE VARIABLE @Mass_01775 ST_Geometry;
SELECT geometry INTO @Mass_01775
FROM Massdata
WHERE ZIP = '01775';

SELECT record_number, proj_geometry
FROM Massdata
WHERE proj_geometry.ST_Touches( @Mass_01775.ST_Transform( 3586 ) ) = 1;
```

See also: "ST_Touches method for type ST_Geometry" on page 207

6. You can use the ST_UnionAggr method to return a geometry that represents the union of a group of zip code areas. For example, suppose you want a geometry reflecting the union of the zip code areas neighboring, but not including, 01775.

   In Interactive SQL, click **Tools** » **Spatial Viewer** and execute the following query:

   ```
   SELECT ST_Geometry::ST_UnionAggr(proj_geometry)
   FROM Massdata
   WHERE proj_geometry.ST_Touches( @Mass_01775.ST_Transform( 3586 ) ) = 1;
   ```

   Double-click the result to view it.

   If you receive an error saying the full column could not be read from the database, increase the **Truncation Length** setting for Interactive SQL. To do this, in Interactive SQL click **Tools** » **Options** » **SQL Anywhere**, and set **Truncation Length** to a higher number. Execute your query again and view the geometry.

   See also: "ST_UnionAggr method for type ST_Geometry" on page 210.

(optional) Restore the sample database (demo.db)

Restore the sample database (demo.db) to its original state by following the steps found here: "Recreate the sample database (demo.db)" [*SQL Anywhere 12 - Introduction*].

Accessing and manipulating spatial data

This section describes the types, methods, and constructors you can use to access, manipulate, and analyze spatial data. The spatial data types can be considered like data types or classes. Each spatial data type has associated methods and constructors you use to access the data.

For compatibility with other products, SQL Anywhere also supports some SQL functions for working with spatial data. In almost all cases, these compatibility functions use one of the spatial methods to perform the operation, so a link to the underlying method is provided. See "Spatial compatibility functions" on page 292.

ST_CircularString type

The ST_CircularString type is a subtype of ST_Curve that uses circular line segments between control points.

Direct supertype

- "ST_Curve type" on page 69

Constructor

- "ST_CircularString constructor" on page 60

Methods

- "ST_NumPoints method for type ST_CircularString" on page 63
- "ST_PointN method for type ST_CircularString" on page 64
- All methods of "ST_Curve type" on page 69 can also be called on a ST_CircularString type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_CircularString type.

Remarks

The ST_CircularString type is a subtype of ST_Curve that uses circular line segments between control points. The first three points define an arc as follows. The first point is the start point of the arc. The second point is any point on the arc other than the start and end point. The third point is the end point of the arc. Subsequent segments are defined by two points only (intermediate and end point). The start point is taken to be the end point of the preceding segment.

A circularstring can be a complete circle with three points if the start and end points are coincident. In this case, the intermediate point is the midpoint of the segment.

If the start, intermediate and end points are collinear, the arc segment is a straight line segment between the start and end point.

A circularstring with exactly three points is a circular arc. A circular ring is a circularstring that is both closed and simple.

Circularstrings are not allowed in round-Earth spatial reference systems. For example, attempting to create one for SRID 4326 returns an error.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3

ST_CircularString constructor

Constructs a circular string

Overload list

Name	Description
"ST_CircularString() constructor" on page 60	Constructs a circular string representing the empty set.
"ST_CircularString(LONG VARCHAR[, INT]) constructor" on page 60	Constructs a circular string from a text representation.
"ST_CircularString(LONG BINARY[, INT]) constructor" on page 61	Constructs a circular string from WKB.
"ST_CircularString(ST_Point,ST_Point,ST_Point,...) constructor" on page 62	Constructs a circular string value from a list of points in a specified spatial reference system.

ST_CircularString() constructor

Constructs a circular string representing the empty set.

Syntax

NEW ST_CircularString()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_CircularString().ST_IsEmpty()
```

ST_CircularString(LONG VARCHAR[, INT]) constructor

Constructs a circular string from a text representation.

Syntax

NEW ST_CircularString(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a circular string. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a circular string from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.2

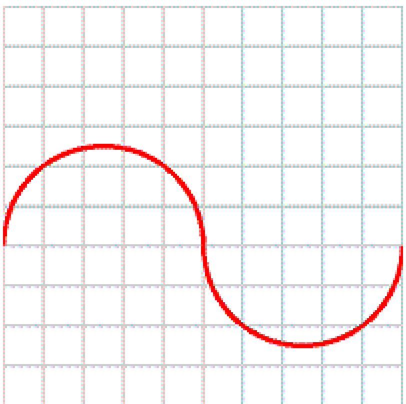
Example

The following returns CircularString (5 10, 10 12, 15 10)

```
SELECT NEW ST_CircularString('CircularString (5 10, 10 12, 15 10)')
```

The following example shows a circularstring with two semi-circle segments.

```
SELECT NEW ST_CircularString('CircularString (0 4, 2.5 6.5, 5 4, 7.5 1.5, 10
4)') CS
```



ST_CircularString(LONG BINARY[, INT]) constructor

Constructs a circular string from WKB.

Syntax

NEW ST_CircularString(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the binary representation of an circular string. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a circular string from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.2

Example

The following returns CircularString (5 10, 10 12, 15 10)

```
SELECT NEW
ST_CircularString(0x010800000003000000000000000000000014400000000000000024400000000
000002440000000000000002840000000000000002e400000000000002440)
```

ST_CircularString(ST_Point,ST_Point,ST_Point,...) constructor

Constructs a circular string value from a list of points in a specified spatial reference system.

Syntax

NEW ST_CircularString(*pt1*,*pt2*,*pt3*,[*pt4*,...,*ptN*])

Parameters

Name	Type	Description
pt1	ST_Point	The first point of an arc.
pt2	ST_Point	Any point on the arc between the first and last point.
pt3	ST_Point	The last point of an arc.
pt4,...,ptN	ST_Point	Additional points defining further arcs, each starting with the previous end point, passing through the first additional point and ending with the second additional point.

Remarks

Constructs a circular string value from a list of points. At least three points must be provided. The first of these three is the start of an arc, the third point is the end of the arc, and the second point is any point on the arc between the first and third point. Additional points can be specified in pairs to add more arcs to the circular string. All of the specified points must have the same SRID. The circular string is constructed with this common SRID. All of the supplied points must be non-empty and have the same answer for Is3D and IsMeasured. The circular string is 3D if all of the points are 3D, and the circular string is measured if all of the points are measured.

> **Note**
> By default, ST_CircularString uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns an error: at least three points must be specified.

```
SELECT NEW ST_CircularString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ) )
```

The following example returns the result `CircularString (0 0, 1 1, 2 0)`.

```
SELECT NEW ST_CircularString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ), NEW
ST_Point(2,0) )
```

The following returns an error: the first circular arc takes three points, and subsequent arcs take two points.

```
SELECT NEW ST_CircularString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ), NEW
ST_Point(2,0), NEW ST_Point(1,-1) )
```

The following example returns the result `CircularString (0 0, 1 1, 2 0, 1 -1, 0 0)`.

```
SELECT NEW ST_CircularString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ), NEW
ST_Point(2,0), NEW ST_Point(1,-1), NEW ST_Point( 0, 0 ) )
```

ST_NumPoints method for type ST_CircularString

Returns the number of points defining the circular string.

> **Note**
> By default, ST_NumPoints uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

circularstring-expression.**ST_NumPoints**()

Returns

- **INT** Returns NULL if the circular string value is empty, otherwise the number of points in the value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.4

ST_PointN method for type ST_CircularString

Returns the *n*th point in the circular string.

> **Note**
> By default, ST_PointN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

Syntax

circularstring-expression.**ST_PointN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *circularstring-expression*.ST_NumPoints().

Returns

- **ST_Point** If the linestring value is the empty set, returns NULL. If the specified position *n* is less than 1 or greater than the number of points, raises a warning and returns NULL. Otherwise, returns the ST_Point value at position n.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *circularstring-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.5

ST_CompoundCurve type

A compound curve is a sequence of ST_Curve values such that adjacent curves are joined at their endpoints. The contributing curves are limited to ST_LineString and ST_CircularString. The start point of each curve after the first is coincident with the end point of the previous curve.

Direct supertype

- "ST_Curve type" on page 69

Constructor

- "ST_CompoundCurve constructor" on page 65

Methods

- "ST_CurveN method for type ST_CompoundCurve" on page 68
- "ST_NumCurves method for type ST_CompoundCurve" on page 69
- All methods of "ST_Curve type" on page 69 can also be called on a ST_CompoundCurve type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_CompoundCurve type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4

ST_CompoundCurve constructor

Constructs a compound curve

Overload list

Name	Description
"ST_CompoundCurve() constructor" on page 65	Constructs a compound curve representing the empty set.
"ST_CompoundCurve(LONG VARCHAR[, INT]) constructor" on page 66	Constructs a compound curve from a text representation.
"ST_CompoundCurve(LONG BINARY[, INT]) constructor" on page 66	Constructs a compound curve from WKB.
"ST_CompoundCurve(ST_Curve,...) constructor" on page 67	Constructs a compound curve from a list of curves.

ST_CompoundCurve() constructor

Constructs a compound curve representing the empty set.

Syntax

NEW ST_CompoundCurve()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_CompoundCurve().ST_IsEmpty()
```

ST_CompoundCurve(LONG VARCHAR[, INT]) constructor

Constructs a compound curve from a text representation.

Syntax

NEW ST_CompoundCurve(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a compound curve. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a compound curve from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.2

Example

The following returns CompoundCurve ((0 0, 5 10), CircularString (5 10, 10 12, 15 10))

```
SELECT NEW ST_CompoundCurve('CompoundCurve ((0 0, 5 10), CircularString (5
10, 10 12, 15 10))')
```

ST_CompoundCurve(LONG BINARY[, INT]) constructor

Constructs a compound curve from WKB.

Syntax

NEW ST_CompoundCurve(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the binary representation of an compound curve. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a compound curve from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.2

Example

The following returns CompoundCurve ((0 0, 5 10))

```
SELECT NEW
ST_CompoundCurve(0x0109000000010000000102000000020000000000000000000000000000
0000000000000000000000144000000000000002440)
```

ST_CompoundCurve(ST_Curve,...) constructor

Constructs a compound curve from a list of curves.

Syntax

NEW ST_CompoundCurve(*curve1*,[*curve2*,...,*curveN*])

Parameters

Name	Type	Description
curve1	ST_Curve	The first curve to include in the compound curve.
curve2,...,curveN	ST_Curve	Additional curves to include in the compound curve.

Remarks

Constructs a compound curve from a list of constituent curves. The start point of each curve after the first must be coincident with the end point of the previous curve. All of the supplied curves must have the same SRID. The compound curve is constructed with this common SRID. All of the supplied curves must be non-empty and have the same answer for Is3D and IsMeasured. The compound curve is 3D if all of the points are 3D, and the compound curve is measured if all of the points are measured.

> **Note**
> By default, ST_CompoundCurve uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns CompoundCurve ((0 0, 5 10), CircularString (5 10, 10 12, 15 10))

```
SELECT NEW ST_CompoundCurve(NEW ST_LineString( 'LineString(0 0, 5 10)'),NEW
ST_CircularString('CircularString (5 10, 10 12, 15 10)'))
```

ST_CurveN method for type ST_CompoundCurve

Returns the *n*th curve in the compound curve.

> **Note**
> By default, ST_CurveN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

compoundcurve-expression.**ST_CurveN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *compoundcurve-expression*.ST_NumCurves().

Returns

- **ST_Curve** Returns the *n*th curve in the compound curve.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *compoundcurve-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.5

ST_NumCurves method for type ST_CompoundCurve

Returns the number of curves defining the compound curve.

Note
By default, ST_NumCurves uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

compoundcurve-expression.**ST_NumCurves**()

Returns

- **INT** Returns the number of curves contained in this compound curve.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.4

ST_Curve type

The ST_Curve type is a supertype for types representing lines using a sequence of points.

Direct supertype

- "ST_Geometry type" on page 88

Direct subtypes

- "ST_CircularString type" on page 59
- "ST_CompoundCurve type" on page 64
- "ST_LineString type" on page 223

Methods

- "ST_CurveToLine method for type ST_Curve" on page 70
- "ST_EndPoint method for type ST_Curve" on page 70
- "ST_IsClosed method for type ST_Curve" on page 71
- "ST_IsRing method for type ST_Curve" on page 71
- "ST_Length method for type ST_Curve" on page 72
- "ST_StartPoint method for type ST_Curve" on page 73

- All methods of "ST_Geometry type" on page 88 can also be called on a ST_Curve type.

Remarks

The ST_Curve type is a supertype for types representing lines using a sequence of points. Subtypes specify whether the control points are joined using straight segments (ST_LineString), circular segments

(ST_CircularString) or a combination (ST_CompoundCurve). The ST_Curve type is not instantiable. An ST_Curve value is simple if it does not intersect itself (except possibly at the end points). If an ST_Curve value does intersect at its endpoints, it is closed. An ST_Curve value that is both simple and closed is called a ring.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1

ST_CurveToLine method for type ST_Curve

Returns the ST_LineString approximation of an ST_Curve value.

> **Note**
> By default, ST_CurveToLine uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curve-expression.**ST_CurveToLine**()

Returns

- **ST_LineString** If the curve value is empty, returns an empty set of type ST_LineString. Otherwise, returns an approximation of the curve as a linestring

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curve-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.7

ST_EndPoint method for type ST_Curve

Returns an ST_Point value that is the end point of the ST_Curve value.

> **Note**
> By default, ST_EndPoint uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curve-expression.**ST_EndPoint**()

Returns

- **ST_Point** If the curve is an empty set, returns NULL. Otherwise, returns the end point of the curve.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curve-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.4

ST_IsClosed method for type ST_Curve

Test if the ST_Curve value is closed. A curve is closed if the start and end points are coincident.

> **Note**
> By default, ST_IsClosed uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curve-expression.**ST_IsClosed**()

Returns

- **BIT** Returns 1 if the curve is closed (and non empty). Otherwise, returns 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.5

ST_IsRing method for type ST_Curve

Tests if the ST_Curve value is a ring. A curve is a ring if it is closed and simple (no self intersections).

Syntax

curve-expression.**ST_IsRing**()

Returns

- **BIT** Returns 1 if the curve is a ring (and non empty). Otherwise, returns 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.6

ST_Length method for type ST_Curve

Returns the length measurement of the ST_Curve value. The result is measured in the units specified by the unit-name parameter.

Syntax

curve-expression.**ST_Length**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VARCHAR(128)	The units in which the length should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** If the curve is an empty set, returns NULL. Otherwise, returns the length of the curve in the specified units.

Remarks

The ST_Length method returns the length of a curve in the units identified by the *unit-name* parameter. If the curve is empty, then NULL is returned.

If the curve contains Z values, these are not considered when computing the length of the geometry.

Note
If the *curve-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Length uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_Length method for type ST_MultiCurve" on page 233

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.2

Example

The following example returns the result 2.

```
SELECT NEW ST_LineString( 'LineString(1 0, 1 1, 2 1)' ).ST_Length()
```


The following example creates a circularstring representing a half-circle and uses ST_Length to find the length of the geometry, returning the value PI.

```
SELECT NEW ST_CircularString( 'CircularString( 0 0, 1 1, 2 0 )' ).ST_Length()
```

The following example creates a linestring representing a path from Halifax, NS to Waterloo, ON, Canada and uses ST_Length to find the length of the path in metres, returning the result `1361967.76789`.

```
SELECT NEW ST_LineString( 'LineString( -63.573566 44.646244, -80.522372
43.465187 )', 4326 )
        .ST_Length()
```

The following example creates an empty linestring and uses ST_Length to find the length of the geometry. The example returns NULL.

```
begin
    declare @curve ST_Curve;
    set @curve = NEW ST_LineString('LineString EMPTY');
    SELECT @curve.ST_Length('metre');
end
```

The following example creates a linestring and an example unit of measure (example_unit_halfmetre). The ST_Length method finds the length of the geometry in this unit of measure, returning the value 4.0.

```
begin
    declare @curve ST_Curve;
    CREATE SPATIAL UNIT OF MEASURE IF NOT EXISTS  "example_unit_halfmetre"
TYPE LINEAR CONVERT USING .5;
    set @curve = NEW ST_LineString( 'LineString(1 0, 1 1, 2 1)' ) ;
    SELECT @curve.ST_Length('example_unit_halfmetre');
end
```

ST_StartPoint method for type ST_Curve

Returns an ST_Point value that is the start point of the ST_Curve value.

> **Note**
> By default, ST_StartPoint uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curve-expression.**ST_StartPoint**()

Returns

- **ST_Point** If the curve is an empty set, returns NULL. Otherwise, returns the start point of the curve.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curve-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.1.3

ST_CurvePolygon type

An ST_CurvePolygon represents a planar surface defined by one exterior ring and zero or more interior rings

Direct supertype

- "ST_Surface type" on page 288

Direct subtypes

- "ST_Polygon type" on page 273

Constructor

- "ST_CurvePolygon constructor" on page 74

Methods

- "ST_CurvePolyToPoly method for type ST_CurvePolygon" on page 79
- "ST_ExteriorRing method for type ST_CurvePolygon" on page 79
- "ST_InteriorRingN method for type ST_CurvePolygon" on page 81
- "ST_NumInteriorRing method for type ST_CurvePolygon" on page 82
- All methods of "ST_Surface type" on page 288 can also be called on a ST_CurvePolygon type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_CurvePolygon type.

Remarks

An ST_CurvePolygon represents a planar surface defined by one exterior ring and zero or more interior rings that represent holes in the surface. The exterior and interior rings of an ST_CurvePolygon can be any ST_Curve value. For example, a circle is an ST_CurvePolygon with an ST_CircularString exterior ring representing the boundary. No two rings in an ST_CurvePolygon can intersect except possibly at a single point. Further, an ST_CurvePolygon cannot have cut lines, spikes, or punctures.

The interior of every ST_CurvePolygon is a connected point set.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2

ST_CurvePolygon constructor

Constructs a curve polygon

Overload list

Name	Description
"ST_CurvePolygon() constructor" on page 75	Constructs a curve polygon representing the empty set.
"ST_CurvePolygon(LONG VARCHAR[, INT]) constructor" on page 75	Constructs a curve polygon from a text representation.
"ST_CurvePolygon(LONG BINARY[, INT]) constructor" on page 76	Constructs a curve polygon from WKB.
"ST_CurvePolygon(ST_Curve,...) constructor" on page 77	Creates a curve polygon from a curve representing the exterior ring and a list of curves representing interior rings, all in a specified spatial reference system.
"ST_CurvePolygon(ST_MultiCurve[, VARCHAR(128)]) constructor" on page 78	Creates a curve polygon from a multi curve containing an exterior ring and an optional list of interior rings.

ST_CurvePolygon() constructor

Constructs a curve polygon representing the empty set.

Syntax

NEW ST_CurvePolygon()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_CurvePolygon().ST_IsEmpty()
```

ST_CurvePolygon(LONG VARCHAR[, INT]) constructor

Constructs a curve polygon from a text representation.

Syntax

NEW ST_CurvePolygon(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a curve polygon. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a curve polygon from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.2

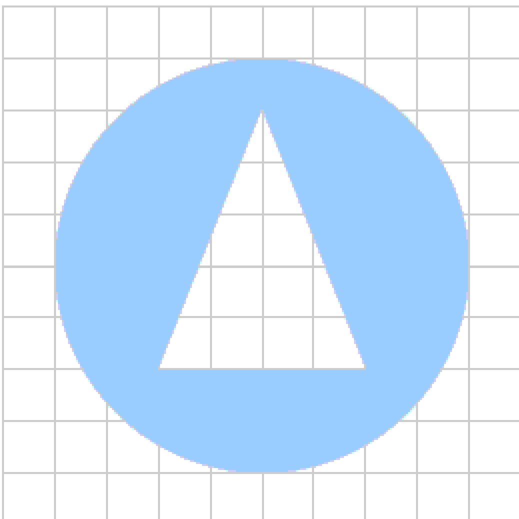
Example

The following returns CurvePolygon (CompoundCurve (CircularString (-5 -5, 0 -5, 5 -5), (5 -5, 0 5, -5 -5)))

```
SELECT NEW ST_CurvePolygon('CurvePolygon (CompoundCurve (CircularString (-5
-5, 0 -5, 5 -5), (5 -5, 0 5, -5 -5)))')
```

The following example shows a curvepolygon with a circle as an outer ring and a triangle inner ring.

```
SELECT NEW ST_CurvePolygon('CurvePolygon ( CircularString (2 0, 5 3, 2 0), (3
1, 4 2, 5 1, 3 1)  )') cpoly
```



ST_CurvePolygon(LONG BINARY[, INT]) constructor

Constructs a curve polygon from WKB.

Syntax

NEW ST_CurvePolygon(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an curve polygon. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a curve polygon from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.2

Example

The following returns CurvePolygon (CircularString (0 0, 10 0, 10 10, 0 10, 0 0))

```
SELECT NEW
ST_CurvePolygon(0x010a0000000100000001080000000500000000000000000000000000000000
0000000000000000000002440000000000000000000000000000000244000000000000024400000
0000000000000000000000002440000000000000000000000000000000000)
```

ST_CurvePolygon(ST_Curve,...) constructor

Creates a curve polygon from a curve representing the exterior ring and a list of curves representing interior rings, all in a specified spatial reference system.

Syntax

NEW ST_CurvePolygon(*exterior-ring*,[*interior-ring1*,...,*interior-ringN*])

Parameters

Name	Type	Description
exterior-ring	ST_Curve	The exterior ring of the curve polygon
interior-ring1,...,interior-ringN	ST_Curve	Interior rings of the curve polygon

Remarks

Creates a curve polygon from a curve representing the exterior ring and a list (possibly empty) of curves representing interior rings. All of the specified rings must have the same SRID. The polygon is created with this common SRID. All of the supplied rings must be non-empty and have the same answer for Is3D and IsMeasured. The polygon is 3D if all of the points are 3D, and the polygon is measured if all of the points are measured.

> **Note**
> By default, ST_CurvePolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

The ability to specify a varying length list of interior rings is a vendor extension.

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.2

Example

The following returns CurvePolygon ((-5 -1, 5 -1, 0 9, -5 -1), CircularString (-2 2, -2 4, 2 4, 2 2, -2 2)) (a triangle with a circular hole).

```
SELECT NEW ST_CurvePolygon(
    NEW ST_LineString ('LineString (-5 -1, 5 -1, 0 9, -5 -1)'),
    NEW ST_CircularString ('CircularString (-2 2, -2 4, 2 4, 2 2, -2 2)'))
```

ST_CurvePolygon(ST_MultiCurve[, VARCHAR(128)]) constructor

Creates a curve polygon from a multi curve containing an exterior ring and an optional list of interior rings.

Syntax

NEW ST_CurvePolygon(*multi-curve*[, *polygon-format*])

Parameters

Name	Type	Description
multi-curve	ST_MultiCurve	A multicurve value containing an exterior ring and (optionally) a set of interior rings.
polygon-format	VARCHAR(128)	A string with the polygon format to use when interpreting the provided curves. Valid formats are 'CounterClockwise', 'Clockwise', and 'EvenOdd'

Remarks

Creates a curve polygon from a multi curve containing an exterior ring and an optional list of interior rings.

If specified, the *polygon-format* parameter selects the algorithm the server uses to determine whether a ring is an exterior or interior ring. If not specified, the polygon format of the spatial reference system is used.

For additional information on *polygon-format*, see "POLYGON FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

> **Note**
> By default, ST_CurvePolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns the result `CurvePolygon (CircularString (-2 0, 1 -3, 4 0, 1 3, -2 0), (0 0, 1 1, 2 0, 0 0))` (a circular curve polygon with a triangular hole).

```
SELECT NEW ST_CurvePolygon( NEW ST_MultiCurve(
    'MultiCurve(CircularString( -2 0, 4 0, -2 0 ),(0 0, 2 0, 1 1, 0 0 ))' ) )
```

ST_CurvePolyToPoly method for type ST_CurvePolygon

Returns the approximation of the curve polygon as a polygon.

> **Note**
> By default, ST_CurvePolyToPoly uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curvepolygon-expression.**ST_CurvePolyToPoly**()

Returns

- **ST_Polygon** Returns the approximation of the curve polygon as a polygon.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curvepolygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.7

ST_ExteriorRing method for type ST_CurvePolygon

Retrieves or modifies the exterior ring.

Overload list

Name	Description
"ST_ExteriorRing() method for type ST_CurvePolygon" on page 80	Returns the exterior ring of the curve polygon.
"ST_ExteriorRing(ST_Curve) method for type ST_CurvePolygon" on page 80	Changes the exterior ring of the curve polygon.

ST_ExteriorRing() method for type ST_CurvePolygon

Returns the exterior ring of the curve polygon.

> **Note**
> By default, ST_ExteriorRing uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curvepolygon-expression.**ST_ExteriorRing**()

Returns

- **ST_Curve** Returns the exterior ring.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curvepolygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.3

ST_ExteriorRing(ST_Curve) method for type ST_CurvePolygon

Changes the exterior ring of the curve polygon.

> **Note**
> By default, ST_ExteriorRing uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curvepolygon-expression.**ST_ExteriorRing**(*exterior-ring*)

Parameters

Name	Type	Description
exterior-ring	ST_Curve	The new exterior ring value.

Returns

- **ST_CurvePolygon** Returns a copy of the curve polygon value with the exterior ring modified to be the specified value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curvepolygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.3

ST_InteriorRingN method for type ST_CurvePolygon

Returns the *n*th interior ring in the curve polygon.

> **Note**
> By default, ST_InteriorRingN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curvepolygon-expression.**ST_InteriorRingN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *curvepolygon-expression*.ST_NumInteriorRing().

Returns

- **ST_Curve** Returns the *n*th interior ring in the curve polygon.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *curvepolygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.6

ST_NumInteriorRing method for type ST_CurvePolygon

Returns the number of interior rings in the curve polygon.

> **Note**
> By default, ST_NumInteriorRing uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

curvepolygon-expression.**ST_NumInteriorRing**()

Returns

- **INT** Returns the number of interior rings in the curve polygon.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.5

ST_GeomCollection type

An ST_GeomCollection is a collection of zero or more ST_Geometry values.

Direct supertype

- "ST_Geometry type" on page 88

Direct subtypes

- "ST_MultiCurve type" on page 229
- "ST_MultiPoint type" on page 240
- "ST_MultiSurface type" on page 250

Constructor

- "ST_GeomCollection constructor" on page 83

Methods

- "ST_GeomCollectionAggr method for type ST_GeomCollection" on page 86
- "ST_GeometryN method for type ST_GeomCollection" on page 87
- "ST_NumGeometries method for type ST_GeomCollection" on page 87
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_GeomCollection type.

Remarks

An ST_GeomCollection is a collection of zero or more ST_Geometry values. All of the values are in the same spatial reference system as the collection value. The ST_GeomCollection type can contain a heterogeneous collection of objects (for example, points, lines, and polygons). Sub-types of ST_GeomCollection can be used to restrict the collection to certain geometry types.

The dimension of the geometry collection value is the largest dimension of its constituents.

A geometry collection is simple if all of the constituents are simple and no two constituent geometries intersect except possibly at their boundaries.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1

ST_GeomCollection constructor

Constructs a geometry collection

Overload list

Name	Description
"ST_GeomCollection() constructor" on page 83	Constructs a geometry collection representing the empty set.
"ST_GeomCollection(LONG VARCHAR[, INT]) constructor" on page 84	Constructs a geometry collection from a text representation.
"ST_GeomCollection(LONG BINARY[, INT]) constructor" on page 84	Constructs a geometry collection from WKB.
"ST_GeomCollection(ST_Geometry,...) constructor" on page 85	Constructs a geometry collection from a list of geometry values.

ST_GeomCollection() constructor

Constructs a geometry collection representing the empty set.

Syntax

NEW ST_GeomCollection()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_GeomCollection().ST_IsEmpty()
```

ST_GeomCollection(LONG VARCHAR[, INT]) constructor

Constructs a geometry collection from a text representation.

Syntax

NEW ST_GeomCollection(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a geometry collection. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a geometry collection from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.2

Example

The following returns GeometryCollection (CircularString (5 10, 10 12, 15 10), Polygon ((10 -5, 15 5, 5 5, 10 -5)))

```
SELECT NEW ST_GeomCollection('GeometryCollection (CircularString (5 10, 10
12, 15 10), Polygon ((10 -5, 15 5, 5 5, 10 -5)))')
```

ST_GeomCollection(LONG BINARY[, INT]) constructor

Constructs a geometry collection from WKB.

Syntax

NEW ST_GeomCollection(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an geometry collection. The in-put can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a geometry collection from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.2

Example

The following returns GeometryCollection (Point (10 20))

```
SELECT NEW
ST_GeomCollection(0x010700000001000000010100000000000000000000244000000000000003
440)
```

ST_GeomCollection(ST_Geometry,...) constructor

Constructs a geometry collection from a list of geometry values.

Syntax

NEW ST_GeomCollection(*geo1*,[*geo2*,...,*geoN*])

Parameters

Name	Type	Description
geo1	ST_Geometry	The first geometry value of the geometry collection.
geo2,...,geoN	ST_Geometry	Additional geometry values of the geometry collection.

Remarks

Constructs a geometry collection from a list of geometry values. All of the supplied geometry values must have the same SRID, and the geometry collection is constructed with this common SRID.

All of the supplied geometry values must have the same answer for Is3D and IsMeasured. The geometry collection is 3D if all of the geometry values are 3D, and the geometry collection is measured if all of the geometry values are measured.

Note
By default, ST_GeomCollection uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a geometry collection containing the single point 'Point (1 2)'

```
SELECT NEW ST_GeomCollection( NEW ST_Point( 1.0, 2.0 ) )
```

The following returns a geometry collection containing two points 'Point (1 2)' and 'Point (3 4)'

```
SELECT NEW ST_GeomCollection( NEW ST_Point( 1.0, 2.0 ), NEW ST_Point( 3.0,
4.0 ) )
```

ST_GeomCollectionAggr method for type ST_GeomCollection

Returns a geometry collection containing all of the geometries in a group

Syntax

ST_GeomCollection::**ST_GeomCollectionAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	**Type**	**Description**
geometry-column	ST_Geometry	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_GeomCollection** Returns a geometry collection that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_GeomCollectionAggr aggregate function can be used to combine a group of geometries into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_GeomCollection has the same coordinate dimension as each geometries.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

Note
By default, ST_GeomCollectionAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_GeometryN method for type ST_GeomCollection

Returns the *n*th geometry in the geometry collection.

Note
By default, ST_GeometryN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

geomcollection-expression.**ST_GeometryN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *geomcollection-expression*.ST_NumGeometries().

Returns

- **ST_Geometry** Returns the *n*th geometry in the geometry collection.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geomcollection-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.5

ST_NumGeometries method for type ST_GeomCollection

Returns the number of geometries contained in the geometry collection.

Note
By default, ST_NumGeometries uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

geomcollection-expression.**ST_NumGeometries**()

Returns

- **INT** Returns the number of geometries stored in this collection.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.4

ST_Geometry type

The ST_Geometry type is the maximal supertype of the geometry type hierarchy.

Direct subtypes

- "ST_Curve type" on page 69
- "ST_GeomCollection type" on page 82
- "ST_Point type" on page 259
- "ST_Surface type" on page 288

Methods

- “ST_IsValid method for type ST_Geometry” on page 170
- “ST_LatNorth method for type ST_Geometry” on page 171
- “ST_LatSouth method for type ST_Geometry” on page 172
- “ST_LinearHash method for type ST_Geometry” on page 173
- “ST_LinearUnHash method for type ST_Geometry” on page 173
- “ST_LoadConfigurationData method for type ST_Geometry” on page 174
- “ST_LongEast method for type ST_Geometry” on page 175
- “ST_LongWest method for type ST_Geometry” on page 176
- “ST_MMax method for type ST_Geometry” on page 177
- “ST_MMin method for type ST_Geometry” on page 177
- “ST_OrderingEquals method for type ST_Geometry” on page 178
- “ST_Overlaps method for type ST_Geometry” on page 180
- “ST_Relate method for type ST_Geometry” on page 181
- “ST_Reverse method for type ST_Geometry” on page 184
- “ST_SRID method for type ST_Geometry” on page 185
- “ST_SRIDFromBaseType method for type ST_Geometry” on page 187
- “ST_SnapToGrid method for type ST_Geometry” on page 187
- “ST_SymDifference method for type ST_Geometry” on page 190
- “ST_ToCircular method for type ST_Geometry” on page 192
- “ST_ToCompound method for type ST_Geometry” on page 193
- “ST_ToCurve method for type ST_Geometry” on page 194
- “ST_ToCurvePoly method for type ST_Geometry” on page 195
- “ST_ToGeomColl method for type ST_Geometry” on page 196
- “ST_ToLineString method for type ST_Geometry” on page 197
- “ST_ToMultiCurve method for type ST_Geometry” on page 198
- “ST_ToMultiLine method for type ST_Geometry” on page 199
- “ST_ToMultiPoint method for type ST_Geometry” on page 200
- “ST_ToMultiPolygon method for type ST_Geometry” on page 201
- “ST_ToMultiSurface method for type ST_Geometry” on page 202
- “ST_ToPoint method for type ST_Geometry” on page 203
- “ST_ToPolygon method for type ST_Geometry” on page 204
- “ST_ToSurface method for type ST_Geometry” on page 206
- “ST_Touches method for type ST_Geometry” on page 207
- “ST_Transform method for type ST_Geometry” on page 208
- “ST_Union method for type ST_Geometry” on page 209
- “ST_UnionAggr method for type ST_Geometry” on page 210
- “ST_Within method for type ST_Geometry” on page 211
- “ST_WithinDistance method for type ST_Geometry” on page 212
- “ST_WithinDistanceFilter method for type ST_Geometry” on page 214
- “ST_WithinFilter method for type ST_Geometry” on page 216
- “ST_XMax method for type ST_Geometry” on page 217
- “ST_XMin method for type ST_Geometry” on page 218
- “ST_YMax method for type ST_Geometry” on page 219
- “ST_YMin method for type ST_Geometry” on page 220
- “ST_ZMax method for type ST_Geometry” on page 221
- “ST_ZMin method for type ST_Geometry” on page 222

Remarks

The ST_Geometry type is the maximal supertype of the geometry type hierarchy. The ST_Geometry type supports methods that can be applied to any spatial value. The ST_Geometry type cannot be instantiated; instead, a subtype should be instantiated. When working with original formats (WKT or WKB), you can use methods such as ST_GeomFromText/ST_GeomFromWKB to instantiate the appropriate concrete type representing the value in the original format.

All of the values in an ST_Geometry value are in the same spatial reference system. The ST_SRID method can be used to retrieve or change the spatial reference system associated with the value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1

ST_Affine method for type ST_Geometry

Returns a new geometry that is the result of applying the specified 3-D affine transformation.

Syntax

geometry-expression.**ST_Affine**(*a00*,*a01*,*a02*,*a10*,*a11*,*a12*,*a20*,*a21*,*a22*,*xoff*,*yoff*,*zoff*)

Parameters

Name	Type	Description
a00	DOUBLE	The affine matrix element in row 0, column 0
a01	DOUBLE	The affine matrix element in row 0, column 1
a02	DOUBLE	The affine matrix element in row 0, column 2
a10	DOUBLE	The affine matrix element in row 1, column 0
a11	DOUBLE	The affine matrix element in row 1, column 1
a12	DOUBLE	The affine matrix element in row 1, column 2
a20	DOUBLE	The affine matrix element in row 2, column 0
a21	DOUBLE	The affine matrix element in row 2, column 1
a22	DOUBLE	The affine matrix element in row 2, column 2
xoff	DOUBLE	The x offset for translation
yoff	DOUBLE	The y offset for translation
zoff	DOUBLE	The z offset for translation

Returns

- **ST_Geometry** Returns a new geometry that is the result of the specified transformation.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

An affine transformation combines rotation, translation and scaling into a single method call. The affine transform is defined using matrix multiplication.

For a point (x,y,z), the result (x',y',z') is computed as follows:

```
/ x' \   / a00 a01 a02 xoff \   / x \
| y' | = | a10 a11 a12 yoff | * | y |
| z' |   | a20 a21 a22 yoff |   | z |
\ w' /   \ 0   0   0   1    /   \ 1 /
```

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns the result `LineString (5 6, 5 3, 9 3)`. The X values are translated by 5 and the Y values are translated by -1.

```
SELECT Shape.ST_Affine( 1,0,0, 0,1,0, 0,0,1, 5,-1,0 )
FROM SpatialShapes WHERE ShapeID = 5
```

The following returns the result `LineString (.698833 6.965029, .399334 3.980017, 4.379351 3.580683)`. The Shape is rotated around the Z axis by 0.1 radians (about 5.7 degrees).

```
SELECT Shape.ST_Affine( cos(0.1),sin(0.1),0, -sin(0.1),cos(0.1),0, 0,0,1,
0,0,0 )
FROM SpatialShapes WHERE ShapeID = 5
```

ST_AsBinary method for type ST_Geometry

Returns the WKB representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsBinary**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the output binary format to use when converting the *geometry-expression* to a binary representation. If not specified, the value of the st_geometry_asbinary_format option is used to choose the binary representation. See "st_geometry_asbinary_format option" [*SQL Anywhere Server - Database Administration*].

Returns

- **LONG BINARY** Returns the WKB representation of the *geometry-expression*.

Remarks

The ST_AsBinary method returns a binary string representing the geometry. A number of different binary formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the st_geometry_asbinary_format option is used to select the output format to use. See "st_geometry_asbinary_format option" [*SQL Anywhere Server - Database Administration*].

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name

format-name(parameter1=value1;parameter2=value2;...)

parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'WKB'.

The following format names may be used:

- **WKB** The Well-Known Binary format defined by SQL/MM and the OGC.
- **EWKB** The Extended Well-Known Binary format defined by PostGIS. This format includes the geometry's SRID and it differs from WKB in the way it represents Z and M values.

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
WKB	Version	1.2	• **1.1** The WKB defined by OGC SFS 1.1. This format does not contain Z and M values. If the geometry contains Z or M values, they are removed in the output. • **1.2** The WKB defined by OGC SFS 1.2. This matches version 1.1 on 2D data and extends the format to support Z and M values.	The version parameter controls the version of the WKB specification used.

Note
When converting a geometry value to BINARY, the server uses the ST_AsBinary method. The st_geometry_asbinary_format option defines the format that is used for the conversion. See "st_geometry_asbinary_format option" [*SQL Anywhere Server - Database Administration*].

Note
By default, ST_AsBinary uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.37

Example

If the st_geometry_asbinary_format option has its default value of 'WKB', the following returns the result `0x01b90b0000000000000000f03f000000000000004000000000000008400000000000001040`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsBinary()
```

If the st_geometry_asbinary_format option has its default value of 'WKB', the following returns the result `0x01b90b0000000000000000f03f000000000000004000000000000008400000000000001040`. The server implicitly invokes the ST_AsBinary method when converting geometries to BINARY.

```
SELECT CAST( NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ) AS LONG BINARY)
```


The following returns the result `0x0101000000000000000000f03f0000000000000040`. The Z and M values are omitted because version 1.1 of the OGC specification for WKB does not support these.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsBinary('WKB(Version=1.1)')
```

The following returns the result `0x01010000e0e6100000000000000000f03f0000000000000040000000000000084000000000000001040`. The extended WKB contains the SRID.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsBinary('EWKB')
```

ST_AsGML method for type ST_Geometry

Returns the GML representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsGML**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the parameters to use when converting the *geometry-expression* to a GML representation. If not specified, the default is 'GML'.

Returns

- **LONG VARCHAR** Returns the GML representation of the *geometry-expression*.

Remarks

The ST_AsGML method returns a GML string representing the geometry. A number of different formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'GML'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
```

```
format-name(parameter1=value1;parameter2=value2;...)
```

```
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'GML'.

The following format names may be used:

- **GML** The Geography Markup Language format defined by ISO 19136 and the OGC.

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	Namespace	none	• **local** Provides a default namespace attribute for the given element (in this case Point) and its sub elements. • **global** Provides a dedicated ("gml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "gml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.
GML	SRSNameFormat	short	• **short** Uses a short format for the spatial reference system name, for example EPSG:4326 • **long** Uses a long format for the spatial reference system name, for example urn:x-ogc:def:crs:EPSG:4326. • **none** Spatial reference system name attribute is not included for the geometry.	The SRSNameFormat parameter specifies the format for the srsName attribute.
GML	SRSDimension	No	**Yes** or **No**	The SRSDimension parameter specifies the number of coordinate values for the given geometry. This only applies to GML(version=3).

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	SRSFillAll	No	**Yes** or **No**	The SRSFillAll parameter specifies whether or not SRS attributes should be propagated to child geometry elements. As an example a MultiGeometry or MultiPolygon would propagate the attributes to its child geometries.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	UseDeprecated	No	**Yes** or **No**	The UseDeprecated parameter only applies to GML(version=3). It is used to output older GML representations where possible. As an example a Surface may be output as a Polygon if the geometry contains no CircularStrings.
GML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.
GML	SubElement	Automatically generated GML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified.

> **Note**
> By default, ST_AsGML uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.39

Example

The following example returns the result `<Point srsName="EPSG:4326"><pos>1 2 3 4</pos></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsGML()
```

The following example returns the result `<Point srsName="EPSG:4326"><coordinates>1,2</coordinates></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsGML('GML(Version=2)')
```

The following returns the result `<gml:Point srsName="EPSG:4326"><gml:coordinates>1,2</gml:coordinates></gml:Point>`. The Namespace=global parameter provides a dedicated ("gml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "gml" prefix.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsGML('GML(Version=2;Namespace=global)')
```

The following returns the result `<Point srsName="EPSG:4326"><coordinates>1,2</coordinates></Point>`. No namespace information is included in the output.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsGML('GML(Version=2;Namespace=none)')
```

The following returns the result `<Point srsName="http://www.opengis.net/gml/srs/epsg.xml#4326"><coordinates>1,2</coordinates></Point>`. The long format of the srsName attribute is used.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsGML('GML(Version=2;Namespace=none;SRSNameFormat=long)')
```

The following returns the result `<Point srsName="urn:x-ogc:def:crs:EPSG:4326"><pos>1 2 3 4</pos></Point>`. The long format of the srsName attribute is used and the format differs in version 3 from the version 2 format.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsGML('GML(Version=3;Namespace=none;SRSNameFormat=long)')
```

ST_AsGeoJSON method for type ST_Geometry

Returns a string representing a geometry in JSON format.

Syntax

geometry-expression.**ST_AsGeoJSON**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining parameters controlling how the GeoJSON result is generated. If not specified, the default is 'GeoJSON'.

Returns

- **LONG VARCHAR** Returns the GeoJSON representation of the *geometry-expression*.

Remarks

The GeoJSON standard defines a geospatial interchange format based on the JavaScript Object Notation (JSON). This format is suited to web-based applications and it can provide a format that is more concise and easier to interpret than WKT or WKB. See http://geojson.org/geojson-spec.html.

The ST_AsGeoJSON method returns a text string representing the geometry. A number of different text formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'GeoJSON'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
```

```
format-name(parameter1=value1;parameter2=value2;...)
```

```
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'GeoJSON'.

The following format names may be used:

- **GeoJSON** The GeoJSON format uses JavaScript Object Notation (JSON) as defined by http://geojson.org/geojson-spec.html.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GeoJSON	Version	1.0	1.0	The version of the GeoJSON specification to follow. At present, only 1.0 is supported.

Note
By default, ST_AsGeoJSON uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `{"type":"Point", "coordinates":[1,2]}` .

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsGeoJSON()
```

ST_AsKML method for type ST_Geometry

Returns the KML representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsKML**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the parameters to use when converting the *geometry-expression* to a KML representation. If not specified, the default is 'KML'.

Returns

- **LONG VARCHAR** Returns the KML representation of the *geometry-expression*.

Remarks

The ST_AsKML method returns a KML string representing the geometry. A number of different formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'KML'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name

format-name(parameter1=value1;parameter2=value2;...)

parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'KML'.

The following format names may be used:

- **KML** The Keyhole Markup Language format defined by the OGC.

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
KML	Version	2	2	KML version 2.2 is supported.
KML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.
KML	Namespace	none	• **local** Provides the default namespace attribute **http://www.opengis.net/kml/2.2** for the given geometry element (in this case Point) and its sub elements. • **global** Provides a dedicated ("kml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "kml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.

Format Name	Parameter Name	Default Value	Allowed Values	Description
KML	SubElement	Automatically generated KML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified. As an example extrude, tessellate and altitudeMode elements may be specified.

> **Note**
> By default, ST_AsKML uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.39

Example

The following example returns the result `<Point><coordinates>1,2,3,4</coordinates></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsKML()
```

The following example returns the result `<Point><coordinates>1,2,3,4</coordinates></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsKML('KML(Version=2)')
```

The following returns the result `<kml:Point><kml:coordinates>1,2,3,4</kml:coordinates></kml:Point>`. The Namespace=global parameter provides a dedicated ("kml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "kml" prefix.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsKML('KML(Version=2;Namespace=global)')
```

The following returns the result `<Point><coordinates>1,2,3,4</coordinates></Point>`. No namespace information is included in the output.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsKML('KML(Version=2;Namespace=none)')
```

The following returns the result `<Point xmlns="http://www.opengis.net/kml/2.2"><coordinates>1,2,3,4</coordinates></Point>`. The default xml namespace is used.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsKML('KML(Version=2;Namespace=default)')
```

The following returns the result `<Point><altitudeMode>absolute</altitudeMode><coordinates>1,2,3,4</coordinates></Point>`. An AltitudeMode sub element is included in the output.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0,
4326 ).ST_AsKML('SubElement=<altitudeMode>absolute</altitudeMode>')
```

ST_AsSVG method for type ST_Geometry

Returns an SVG figure representing a geometry value.

Syntax

geometry-expression.**ST_AsSVG**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the parameters to use when converting the *geometry-expression* to a SVG representation. If not specified, the default is 'SVG'.

Returns

- **LONG VARCHAR** Returns a complete or partial SVG document which renders the *geometry-expression*.

Remarks

The ST_AsSVG method returns a complete or partial SVG document that can be used to graphically display geometries using an SVG viewer. Most major web browsers with the exception of Microsoft Internet Explorer include built-in SVG viewers.

A number of different options are supported and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'SVG'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

format-name

format-name(parameter1=value1;parameter2=value2;...)

parameter1=value1;parameter2=value2;...

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'SVG'.

The following format names may be used:

- **SVG** The Scalable Vector Graphics (SVG) 1.1 format defined by the World Wide Web Consortium (W3C).

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	Approximate	Yes	**Yes** or **No**	The Approximate parameter specifies whether or not to reduce the size of the output SVG document with a slight reduction in visible detail. The SVG data is approximated by not including points which are within the line width of the last point. With multiple megabyte geometries this can result in compression rates of 80% or more.
SVG	Attribute	Automatically generated optional attributes	One or more SVG attributes that can be applied to SVG shape elements	By default, optional SVG shape attributes such as fill, stroke and stroke-width are generated. If the Attributes parameter is specified, then no optional SVG shape attributes are generated, and the Attribute value is used instead. Ignored if PathDataOnly=Yes is specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	DecimalDigits	Based on the number of decimal digits in the spatial reference system's snap to grid gridsize. The maximum default value is 5 and the minimum is 0.	integer	The DecimalDigits parameter limits the number of digits after the decimal place for coordinates generated in the SVG output. Specifying a negative number of digits indicates that the full precision of coordinates should be included in the SVG output.
SVG	PathDataOnly	No (a complete SVG document is generated)	**Yes** or **No**	The PathDataOnly parameter specifies whether or not only data for the SVG Path Element should be generated. The PathDataOnly example below demonstrates how PathDataOnly=Yes can be used to build a complete SVG document that can be displayed. By default a complete SVG document is generated. The path data returned by PathDataOnly=Yes can be used to build more flexible SVG documents containing other elements, such as text.
SVG	RandomFill	Yes	**Yes** or **No**	The RandomFill parameter specifies whether or not polygons should be filled by a randomly generated color. The sequence of colors used does not follow a well-defined sequence, and typically changes each time SVG output is generated. **No** indicates that only an outline of each polygon is drawn. The RandomFill parameter is ignored if the Attribute or PathDataOnly=Yes parameter is specified.
SVG	Relative	Yes	**Yes** or **No**	The Relative parameter specifies if coordinates should be output in relative (offset) or absolute formats. Relative coordinate data is typically more compact than absolute coordinate data.

> **Note**
> By default, ST_AsSVG uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_AsSVGAggr method for type ST_Geometry" on page 107

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a complete SVG document with polygons filled with random colors.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
            .ST_AsSVG()
```

The following returns a complete SVG document with outlined polygons and limits coordinates to 3 digits after the decimal place.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
            .ST_AsSVG( 'RandomFill=No;DecimalDigits=3' )
```

The following returns a complete SVG documents with polygons filled with blue and coordinates with maximum precision. Any Shapes containing curves will contain invalid SVG because both fill="none" and fill="blue" are generated.

```
SELECT Shape.ST_AsSVG( 'Attribute=fill="blue";DecimalDigits=-1' )
FROM SpatialShapes
```

The following returns a complete SVG document from SVG path data with relative coordinates limited to 5 digits after the decimal place.

```
SELECT '<?xml version="1.0" standalone="no"?>
    <!DOCTYPE svg PUBLIC "-//W3C//DTD SVG 1.1//EN"
    "http://www.w3.org/Graphics/SVG/1.1/DTD/svg11.dtd">
    <svg viewBox="-180 -90 360 180" xmlns="http://www.w3.org/2000/svg"
        version="1.1">
        <path fill="lightblue" stroke="black" stroke-width="0.1%" d="' ||
    NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
        .ST_AsSVG( 'PathDataOnly=Yes' ) ||
       '"/></svg>'
```

The following returns SVG path data using absolute coordinates limited to 7 digits after the decimal place.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
            .ST_AsSVG( 'PathDataOnly=Yes;Relative=No;DecimalDigits=7' )
```

ST_AsSVGAggr method for type ST_Geometry

Returns a complete or partial SVG document which renders the geometries in a group.

Syntax

ST_Geometry::**ST_AsSVGAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...] [, *format*])

Parameters

Name	Type	Description
geometry-column	ST_Geometry	The geometry value to contribute to the SVG figure. Typically this is a column.
format	VARCHAR(128)	A string defining the parameters to use when converting each geometry value to a SVG representation. If not specified, the default is 'SVG'.

Returns

- **LONG VARCHAR** Returns a complete or partial SVG document which renders the geometries in a group.

Remarks

The ST_AsSVGAggr method returns a complete or partial SVG document that can be used to graphically display the union of a group of geometries using an SVG viewer. Most major web browsers with the exception of Microsoft Internet Explorer include built-in SVG viewers.

A number of different options are supported and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'SVG'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
```

```
format-name(parameter1=value1;parameter2=value2;...)
```

```
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'SVG'.

The following format names may be used:

- **SVG** The Scalable Vector Graphics (SVG) 1.1 format defined by the World Wide Web Consortium (W3C).

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	Approximate	Yes	**Yes** or **No**	The Approximate parameter specifies whether or not to reduce the size of the output SVG document with a slight reduction in visible detail. The SVG data is approximated by not including points which are within the line width of the last point. With multiple megabyte geometries this can result in compression rates of 80% or more.
SVG	Attribute	Automatically generated optional attributes	One or more SVG attributes that can be applied to SVG shape elements	By default, optional SVG shape attributes such as fill, stroke and stroke-width are generated. If the Attributes parameter is specified, then no optional SVG shape attributes are generated, and the Attribute value is used instead. Ignored if PathDataOnly=Yes is specified.
SVG	DecimalDigits	Based on the number of decimal digits in the spatial reference system's snap to grid gridsize. The maximum default value is 5 and the minimum is 0.	integer	The DecimalDigits parameter limits the number of digits after the decimal place for coordinates generated in the SVG output. Specifying a negative number of digits indicates that the full precision of coordinates should be included in the SVG output.
SVG	PathDataOnly	No (a complete SVG document is generated)	**Yes** or **No**	The PathDataOnly parameter specifies whether or not only data for the SVG Path Element should be generated. The PathDataOnly example below demonstrates how PathDataOnly=Yes can be used to build a complete SVG document that can be displayed. By default a complete SVG document is generated. The path data returned by PathDataOnly=Yes can be used to build more flexible SVG documents containing other elements, such as text.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	RandomFill	Yes	**Yes** or **No**	The RandomFill parameter specifies whether or not polygons should be filled by a randomly generated color. The sequence of colors used does not follow a well-defined sequence, and typically changes each time SVG output is generated. **No** indicates that only an outline of each polygon is drawn. The RandomFill parameter is ignored if the Attribute or PathDataOnly=Yes parameter is specified.
SVG	Relative	Yes	**Yes** or **No**	The Relative parameter specifies if coordinates should be output in relative (offset) or absolute formats. Relative coordinate data is typically more compact than absolute coordinate data.

The ORDER BY clause can be specified to control how overlapping geometries are displayed, with geometries displayed in order from back to front. If not specified, the geometries are displayed in an order that depends on the execution plan selected by the query optimizer, and this may vary between executions.

Note
By default, ST_AsSVGAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_AsSVG method for type ST_Geometry" on page 104

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a complete SVG document with polygons filled with random colors.

```
SELECT ST_Geometry::ST_AsSVGAggr( Shape ) FROM SpatialShapes
```

The following returns a complete SVG document from SVG path data with relative coordinates limited to 5 digits after the decimal place.

```
SELECT '<?xml version="1.0" standalone="no"?>
    <!DOCTYPE svg PUBLIC "-//W3C//DTD SVG 1.1//EN"
    "http://www.w3.org/Graphics/SVG/1.1/DTD/svg11.dtd">
    <svg viewBox="-10 -10 20 12" xmlns="http://www.w3.org/2000/svg"
        version="1.1">
        <path fill="lightblue" stroke="black" stroke-width="0.1%" d="' ||
          ST_Geometry::ST_AsSVGAggr( Shape, 'PathDataOnly=Yes' ) ||
```



```
        '"/></svg>'
FROM SpatialShapes
```

ST_AsText method for type ST_Geometry

Returns the text representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsText**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the output text format to use when converting the *geometry-expression* to a text representation. If not specified, the st_geometry_astext_format option is used to choose the text representation. See "st_geometry_astext_format option" [*SQL Anywhere Server - Database Administration*].

Returns

- **LONG VARCHAR** Returns the text representation of the *geometry-expression*.

Remarks

The ST_AsText method returns a text string representing the geometry. A number of different text formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the st_geometry_astext_format option is used to select the output format to use. See "st_geometry_astext_format option" [*SQL Anywhere Server - Database Administration*].

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
```

```
format-name(parameter1=value1;parameter2=value2;...)
```

```
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'WKT'.

The following format names may be used:

- **WKT** The Well-Known Text format defined by SQL/MM and the OGC.

- **EWKT** The Extended Well Known Text format. This format includes the geometry's SRID as a prefix.
- **GML** The Geography Markup Language format defined by ISO 19136 and the OGC.
- **KML** Keyhole Markup Language format defined by OGC.
- **GeoJSON** The GeoJSON format uses JavaScript Object Notation (JSON) as defined by http://geojson.org/geojson-spec.html.
- **SVG** The Scalable Vector Graphics (SVG) 1.1 format defined by the World Wide Web Consortium (W3C).

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
WKT	Version	1.2	• **1.1** The WKT defined by OGC SFS 1.1. This format does not contain Z and M values. If the geometry contains Z or M values, they are removed in the output. • **1.2** The WKT defined by OGC SFS 1.2. This matches version 1.1 on 2D data and extends the format to support Z and M values. • **PostGIS** The WKT format used by some other vendors; Z and M values are included in a fashion that does not match OGC 1.2.	The version parameter controls the version of the WKT specification used.
GML	Version	3	• **2** Version 2 of the GML specification. • **3** Version 3.2 of the GML specification	The version parameter controls the version of the GML specification used.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	Namespace	none	• **local** Provides a default namespace attribute for the given element (in this case Point) and its sub elements. • **global** Provides a dedicated ("gml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "gml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.
GML	SRSNameFormat	short	• **short** Uses a short format for the spatial reference system name, for example EPSG:4326 • **long** Uses a long format for the spatial reference system name, for example urn:x-ogc:def:crs:EPSG:4326. • **none** Spatial reference system name attribute is not included for the geometry.	The SRSNameFormat parameter specifies the format for the srsName attribute.
GML	SRSDimension	No	**Yes** or **No**	The SRSDimension parameter specifies the number of coordinate values for the given geometry. This only applies to GML(version=3).

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	SRSFillAll	No	**Yes** or **No**	The SRSFillAll parameter specifies whether or not SRS attributes should be propagated to child geometry elements. As an example a MultiGeometry or MultiPolygon would propagate the attributes to its child geometries.
GML	UseDeprecated	No	**Yes** or **No**	The UseDeprecated parameter only applies to GML(version=3). It is used to output older GML representations where possible. As an example a Surface may be output as a Polygon if the geometry contains no CircularStrings.
GML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	SubElement	Automatically generated GML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified.
KML	Version	2	2	KML version 2.2 is supported.
KML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.
KML	Namespace	none	• **local** Provides the default namespace attribute **http://www.opengis.net/kml/2.2** for the given geometry element (in this case Point) and its sub elements. • **global** Provides a dedicated ("kml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "kml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.
KML	SubElement	Automatically generated KML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified. As an example extrude, tessellate and altitudeMode elements may be specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GeoJSON	Version	1	1	The version of the GeoJSON specification to follow. At present, only 1.0 is supported.
SVG	Approximate	Yes	**Yes** or **No**	The Approximate parameter specifies whether or not to reduce the size of the output SVG document with a slight reduction in visible detail. The SVG data is approximated by not including points which are within the line width of the last point. With multiple megabyte geometries this can result in compression rates of 80% or more.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	Attribute	Automatically generated optional attributes	One or more SVG attributes that can be applied to SVG shape elements	By default, optional SVG shape attributes such as fill, stroke and stroke-width are generated. If the Attributes parameter is specified, then no optional SVG shape attributes are generated, and the Attribute value is used instead. Ignored if PathDataOnly=Yes is specified.
SVG	DecimalDigits	Based on the number of decimal digits in the spatial reference system's snap to grid gridsize. The maximum default value is 5 and the minimum is 0.	integer	The DecimalDigits parameter limits the number of digits after the decimal place for coordinates generated in the SVG output. Specifying a negative number of digits indicates that the full precision of coordinates should be included in the SVG output.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	PathDataOnly	No (a complete SVG document is generated)	**Yes** or **No**	The PathDataOnly parameter specifies whether or not only data for the SVG Path Element should be generated. The PathDataOnly example below demonstrates how PathDataOnly=Yes can be used to build a complete SVG document that can be displayed. By default a complete SVG document is generated. The path data returned by PathDataOnly=Yes can be used to build more flexible SVG documents containing other elements, such as text.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	RandomFill	Yes	**Yes** or **No**	The RandomFill parameter specifies whether or not polygons should be filled by a randomly generated color. The sequence of colors used does not follow a well-defined sequence, and typically changes each time SVG output is generated. **No** indicates that only an outline of each polygon is drawn. The RandomFill parameter is ignored if the Attribute or PathDataOnly=Yes parameter is specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	Relative	Yes	**Yes** or **No**	The Relative parameter specifies if coordinates should be output in relative (offset) or absolute formats. Relative coordinate data is typically more compact than absolute coordinate data.

Note
When converting a geometry value to VARCHAR or NVARCHAR, the server uses the ST_AsText method. The st_geometry_astext_format option defines the format that is used for the conversion. See "st_geometry_astext_format option" [*SQL Anywhere Server - Database Administration*].

Note
By default, ST_AsText uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_AsGeoJSON method for type ST_Geometry" on page 100
- "ST_AsGML method for type ST_Geometry" on page 95
- "ST_AsKML method for type ST_Geometry" on page 101
- "ST_AsSVG method for type ST_Geometry" on page 104
- "ST_AsWKT method for type ST_Geometry" on page 123

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.35

Example

Assuming that the st_geometry_astext_format option has the value 'WKT' (see "st_geometry_astext_format option" [*SQL Anywhere Server - Database Administration*]) the following returns the result `Point ZM (1 2 3 4)`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsText()
```


Assuming that the st_geometry_astext_format option has the value 'WKT'(see "st_geometry_astext_format option" [*SQL Anywhere Server - Database Administration*]), the following returns the result `Point ZM (1 2 3 4)`. The ST_AsText method is implicitly invoked when converting geometries to VARCHAR or NVARCHAR types.

```
SELECT CAST( NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ) as long varchar)
```

The following returns the result `Point (1 2)`. The Z and M values are not output because they are not supported in version 1.1.0 of the OGC specification for WKT.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsText('WKT(Version=1.1)')
```

The following returns the result `SRID=4326;Point ZM (1 2 3 4)`. The SRID is included in the result as a prefix.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsText('EWKT')
```

The following example returns the result `<Point srsName="EPSG:4326"><pos>1 2 3 4</pos></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsText('GML')
```

The following returns `'{"type":"Point", "coordinates":[1,2]} '`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsText('GeoJSON')
```

The following returns a complete SVG document with polygons filled with random colors.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
            .ST_AsText( 'SVG' )
```

ST_AsWKB method for type ST_Geometry

Returns the WKB representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsWKB**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the WKB format to use when converting the *geometry-expression* to binary. If not specified, the default is 'WKB'.

Returns

- **LONG BINARY**   Returns the WKB representation of the *geometry-expression*.

Remarks

The ST_AsWKB method returns a binary string representing the geometry in WKB format. A number of different formats are supported (with associated options) and the desired format is selected using the optional *format* parameter. If the *format* parameter is not specified, the default is 'WKB'.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name

format-name(parameter1=value1;parameter2=value2;...)

parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'WKB'.

The following format names may be used:

- **WKB** The Well-Known Binary format defined by SQL/MM and the OGC.
- **EWKB** The Extended Well-Known Binary format defined by PostGIS. This format includes the geometry's SRID and it differs from WKB in the way it represents Z and M values.

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
WKB	Version	1.2	• **1.1** The WKB defined by OGC SFS 1.1. This format does not contain Z and M values. If the geometry contains Z or M values, they are removed in the output. • **1.2** The WKB defined by OGC SFS 1.2. This matches version 1.1 on 2D data and extends the format to support Z and M values.	The Version parameter controls the version of the WKB specification used.

Note
By default, ST_AsWKB uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `0x01b90b0000000000000000f03f000000000000004000000000000008400000000000001040`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsWKB()
```

The following returns the result `0x0101000000000000000000f03f0000000000000040`. The Z and M values are omitted because version 1.1 of the OGC specification for WKB does not support these.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsWKB('WKB(Version=1.1)')
```

The following returns the result `0x01010000e0e6100000000000000000f03f000000000000004000000000000008400000000000001040`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsWKB('EWKB')
```

ST_AsWKT method for type ST_Geometry

Returns the WKT representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsWKT**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the output text format to use when converting the *geometry-expression* to WKT. If not specified, the format string defaults to 'WKT'.

Returns

- **LONG VARCHAR** Returns the WKT representation of the *geometry-expression*.

Remarks

The ST_AsWKT method returns a text string representing the geometry. A number of different text formats are supported (with associated options) and the desired format is selected using the optional *format* parameter.

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
format-name(parameter1=value1;parameter2=value2;...)
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'WKT'.

The following format names may be used:

- **WKT** The Well Known Text format defined by SQL/MM and the OGC.
- **EWKT** The Extended Well Known Text format defined by PostGIS. This format includes the geometry's SRID and it differs from WKT in the way it represents Z and M values.

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
WKT	Version	1.2	• **1.1** The WKT defined by OGC SFS 1.1. This format does not contain Z and M values. If the geometry contains Z or M values, they are removed in the output. • **1.2** The WKT defined by OGC SFS 1.2. This matches version 1.1 on 2D data and extends the format to support Z and M values. • **PostGIS** The WKT format used by some other vendors; Z and M values are included in a fashion that does not match OGC 1.2.	The Version parameter controls the version of the WKT specification used.

> **Note**
> By default, ST_AsWKT uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `SRID=0;Polygon ((3 3, 8 3, 4 8, 3 3))`.

```
SELECT Shape.ST_AsWKT( 'EWKT' ) FROM SpatialShapes WHERE ShapeID = 22
```

ST_AsXML method for type ST_Geometry

Returns the XML representation of an ST_Geometry value.

Syntax

geometry-expression.**ST_AsXML**([*format*])

Parameters

Name	Type	Description
format	VARCHAR(128)	A string defining the output text format to use when converting the *geometry-expression* to an XML representation. If not specified, the st_geometry_asxml_format option is used to choose the XML representation. See "st_geometry_asxml_format option" [*SQL Anywhere Server - Database Administration*].

Returns

- **LONG VARCHAR** Returns the XML representation of the *geometry-expression*.

Remarks

The ST_AsXML method returns an XML string representing the geometry. GML, KML and SVG are the supported XML formats. The *format* parameter specifies parameters that control the conversion to XML. If *format* is not specified, the value of the st_geometry_asxml_format option is used to select the output format. See "st_geometry_asxml_format option" [*SQL Anywhere Server - Database Administration*].

The format string defines an output format and parameters to the format. The format string has one of the following formats:

```
format-name
```

```
format-name(parameter1=value1;parameter2=value2;...)
```

```
parameter1=value1;parameter2=value2;...
```

The first format specifies the format name and no parameters. All format parameters use their default values. The second format specifies the format name and a list of named parameter values. Parameters that are not supplied use their default values. The last format specifies only parameter values, and the format name defaults to 'GML'.

The following format names may be used:

- **GML** The Geography Markup Language format defined by ISO 19136 and the OGC.
- **KML** The Keyhole Markup Language format defined by the OGC.
- **SVG** The Scalable Vector Graphics (SVG) 1.1 format defined by the World Wide Web Consortium (W3C).

The following format parameters can be specified:

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	Version	3	• **2** Version 2 of the GML specification. • **3** Version 3.2 of the GML specification	The version parameter controls the version of the GML specification used.
GML	Namespace	none	• **local** Provides a default namespace attribute for the given element (in this case Point) and its sub elements. • **global** Provides a dedicated ("gml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "gml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	SRSNameFormat	short	• **short** Uses a short format for the spatial reference system name, for example EPSG:4326 • **long** Uses a long format for the spatial reference system name, for example urn:x-ogc:def:crs:EPSG:4326. • **none** Spatial reference system name attribute is not included for the geometry.	The SRSNameFormat parameter specifies the format for the srsName attribute.
GML	SRSDimension	No	**Yes** or **No**	The SRSDimension parameter specifies the number of coordinate values for the given geometry. This only applies to GML(version=3).
GML	SRSFillAll	No	**Yes** or **No**	The SRSFillAll parameter specifies whether or not SRS attributes should be propagated to child geometry elements. As an example a MultiGeometry or MultiPolygon would propagate the attributes to its child geometries.

Format Name	Parameter Name	Default Value	Allowed Values	Description
GML	UseDeprecated	No	**Yes** or **No**	The UseDeprecated parameter only applies to GML(version=3). It is used to output older GML representations where possible. As an example a Surface may be output as a Polygon if the geometry contains no CircularStrings.
GML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.
GML	SubElement	Automatically generated GML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified.
KML	Version	2	2	KML version 2.2 is supported.
KML	Attribute	Automatically generated optional attributes	One or more attributes may be specified for the top level geometry element only	Any legal XML attributes may be specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
KML	Namespace	none	• **local** Provides the default namespace attribute **http://www.opengis.net/kml/2.2** for the given geometry element (in this case Point) and its sub elements. • **global** Provides a dedicated ("kml") prefix for the given element and its sub elements. This is useful when the query is used within an aggregate operation, such that, some top level element defines the namespace for the "kml" prefix. • **none** Provides no namespace or prefix for the given element (in this case Point) and its sub elements	The namespace parameter specifies the output format convention for namespace.
KML	SubElement	Automatically generated KML sub elements	One or more sub elements may be specified for the top level geometry element only	Any legal XML elements may be specified. As an example extrude, tessellate and altitudeMode elements may be specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	Approximate	Yes	**Yes** or **No**	The Approximate parameter specifies whether or not to reduce the size of the output SVG document with a slight reduction in visible detail. The SVG data is approximated by not including points which are within the line width of the last point. With multiple megabyte geometries this can result in compression rates of 80% or more.
SVG	Attribute	Automatically generated optional attributes	One or more SVG attributes that can be applied to SVG shape elements	By default, optional SVG shape attributes such as fill, stroke and stroke-width are generated. If the Attributes parameter is specified, then no optional SVG shape attributes are generated, and the Attribute value is used instead. Ignored if PathDataOnly=Yes is specified.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	DecimalDigits	Based on the number of decimal digits in the spatial reference system's snap to grid gridsize. The maximum default value is 5 and the minimum is 0.	integer	The DecimalDigits parameter limits the number of digits after the decimal place for coordinates generated in the SVG output. Specifying a negative number of digits indicates that the full precision of coordinates should be included in the SVG output.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	PathDataOnly	No (a complete SVG document is generated)	**Yes** or **No**	The PathDataOnly parameter specifies whether or not only data for the SVG Path Element should be generated. The PathDataOnly example below demonstrates how PathDataOnly=Yes can be used to build a complete SVG document that can be displayed. By default a complete SVG document is generated. The path data returned by PathDataOnly=Yes can be used to build more flexible SVG documents containing other elements, such as text.

Format Name	Parameter Name	Default Value	Allowed Values	Description
SVG	RandomFill	Yes	**Yes** or **No**	The RandomFill parameter specifies whether or not polygons should be filled by a randomly generated color. The sequence of colors used does not follow a well-defined sequence, and typically changes each time SVG output is generated. **No** indicates that only an outline of each polygon is drawn. The RandomFill parameter is ignored if the Attribute or PathDataOnly=Yes parameter is specified.
SVG	Relative	Yes	**Yes** or **No**	The Relative parameter specifies if coordinates should be output in relative (offset) or absolute formats. Relative coordinate data is typically more compact than absolute coordinate data.

Note
When converting a geometry value to XML, the server uses the ST_AsXML method. The st_geometry_asxml_format option defines the format that is used for the conversion. See "st_geometry_asxml_format option" [*SQL Anywhere Server - Database Administration*].

> **Note**
> By default, ST_AsXML uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_AsGML method for type ST_Geometry" on page 95
- "ST_AsKML method for type ST_Geometry" on page 101
- "ST_AsSVG method for type ST_Geometry" on page 104

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

If the st_geometry_asxml_format option has its default value of 'GML', then the following returns the result `<Point srsName="EPSG:4326"><pos>1 2 3 4</pos></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsXML()
```

If the st_geometry_asxml_format option has its default value of 'GML', then the following returns the result `<Point srsName="EPSG:4326"><pos>1 2 3 4</pos></Point>`.

```
SELECT CAST( NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ) AS XML)
```

The following example returns the result `<Point srsName="EPSG:4326"><coordinates>1,2</coordinates></Point>`.

```
SELECT NEW ST_Point( 1.0, 2.0, 3.0, 4.0, 4326 ).ST_AsXML('GML(Version=2)')
```

The following returns a complete SVG document with polygons filled with random colors.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 20, 60 10, 0 0 ))' )
            .ST_AsXML( 'SVG' )
```

ST_Boundary method for type ST_Geometry

Returns the boundary of the geometry value.

Syntax

geometry-expression.**ST_Boundary**()

Returns

- **ST_Geometry** Returns a geometry value representing the boundary of the *geometry-expression*.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_Boundary method returns the spatial boundary of the *geometry-expression*. Geometries are characterized by their interior, boundary, and exterior. All geometry values are defined to be topologically closed, that is the boundary is considered to be part of the geometry.

Point geometries have an empty boundary. Curve geometries may be closed, in which case they have an empty boundary. If a curve is not closed, the start and end point of the curve form the boundary. For a surface geometry, the boundary is the set of curves that delineate the edge of the surface. For example, for a polygon the boundary of the geometry consists of the exterior ring and any interior rings.

See also: "Geometry interiors, exteriors, and boundaries" on page 42.

Note
If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
This method can not be used with geometries in round-Earth spatial reference system.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.14

Example

The following example construct a geometry collection containing a polygon and a linestring and returns the boundary for the collection. The returned boundary is a collection containing the exterior ring of the polygon and the two end points of the linestring. It is equivalent to the following collection: `'GeometryCollection (LineString (0 0, 3 0, 3 3, 0 3, 0 0), MultiPoint ((0 7), (4 4)))'`

```
SELECT NEW ST_GeomCollection('GeometryCollection (Polygon ((0 0, 3 0, 3 3, 0
3, 0 0)), LineString (0 7, 0 4, 4 4))').ST_Boundary()
```

ST_Contains method for type ST_Geometry

Tests if a geometry value spatially contains another geometry value.

Syntax

geometry-expression.**ST_Contains**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* contains *geo2*, otherwise 0.

Remarks

The ST_Contains method tests if the *geometry-expression* completely contains *geo2* and there is one or more interior points of *geo2* that lies in the interior of the *geometry-expression*.

geometry-expression.ST_Contains(*geo2*) is equivalent to *geo2*.ST_Within(*geometry-expression*).

The ST_Contains and ST_Covers methods are similar. The difference is that ST_Covers does not require intersecting interior points.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Within method for type ST_Geometry" on page 211
- "ST_Covers method for type ST_Geometry" on page 144
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_ContainsFilter method for type ST_Geometry" on page 137

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.31

Example

The following example tests if a polygon contains a point. The polygon completely contains the point, and the interior of the point (the point itself) intersects the interior of the polygon, so the example returns 1.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' )
    .ST_Contains( NEW ST_Point( 1, 1 ) )
```

The following example tests if a polygon contains a line. The polygon completely contains the line, but the interior of the line and the interior of the polygon do not intersect (the line only intersects the polygon on the polygon's boundary, and the boundary is not part of the interior), so the example returns 0. If ST_Covers was used in place of ST_Contains, ST_Covers would return 1.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' )
    .ST_Contains( NEW ST_LineString( 'LineString( 0 0, 1 0 )' ) )
```

The following example lists the ShapeIDs where the given polygon contains each Shape geometry. This example returns the result `16,17,19`. Note that ShapeID 1 is not listed because the polygon intersects that row's Shape point at the polygon's boundary.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
```



```
WHERE NEW ST_Polygon( NEW ST_Point( 0, 0 ),
                      NEW ST_Point( 8, 2 ) ).ST_Contains( Shape ) = 1
```

ST_ContainsFilter method for type ST_Geometry

A cheap test if a geometry might possibly contain another.

Syntax

geometry-expression.**ST_ContainsFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* might contain *geo2*, otherwise 0.

Remarks

The ST_ContainsFilter method provides an efficient test to determine if one geometry might contain the other. Returns 1 if the *geometry-expression* might contain *geo2*, otherwise 0.

This test is cheaper than ST_Contains, but may return 1 in some cases where the *geometry-expression* does not actually contain *geo2*.

Therefore, this method can be useful as a primary filter when further processing will determine whether geometries interact in the desired way.

The implementation of ST_ContainsFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_ContainsFilter is used within a query, the expression *geometry-expression*.ST_ContainsFilter(*geo2*) can return different results when *geometry-expression* does not contain *geo2*. Whenever *geometry-expression* contains *geo2*, ST_ContainsFilter will always return 1.

Note
This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Contains method for type ST_Geometry" on page 135

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_ConvexHull method for type ST_Geometry

Returns the convex hull of the geometry value.

Syntax

geometry-expression.**ST_ConvexHull**()

Returns

- **ST_Geometry** If the geometry value is NULL or an empty value, then NULL is returned. Otherwise, the convex hull of the geometry value is returned.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The convex hull of a geometry is the smallest convex geometry that contains all of the points in the geometry.

The convex hull may be visualized by imagining an elastic band stretched to enclose all of the points in the geometry. When released, the elastic band takes the shape of the convex hull.

If the geometry consists of a single point, the point is returned. If all of the points of the geometry lie on a single straight line segment, a linestring is returned. Otherwise, a convex polygon is returned.

The convex hull can serve as an approximation of the original geometry. When testing a spatial relationship, the convex hull can serve as a quick pre-filter because if there is no spatial intersection with the convex hull then there can be no intersection with the original geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> ST_ConvexHull is not supported on geometries which contain circular strings.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

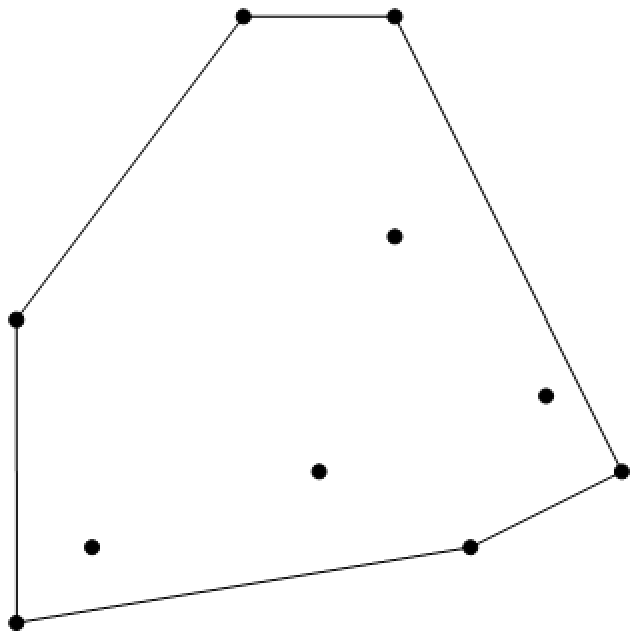
- "ST_ConvexHullAggr method for type ST_Geometry" on page 139

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.16

Example

The following example shows the convex hull computed from 10 points. The resulting hull is the result `Polygon ((1 1, 7 2, 9 3, 6 9, 4 9, 1 5, 1 1))`.



```
SELECT NEW ST_MultiPoint('MultiPoint( (1 1), (2 2), (5 3), (7 2), (9 3), (8
4), (6 6), (6 9), (4 9), (1 5) )').ST_ConvexHull()
```

The following example returns the single point (0,0). The convex hull of a single point is a point.

```
SELECT NEW ST_Point(0,0).ST_ConvexHull()
```

The following example returns the result `LineString (0 0, 3 3)`. The convex hull of a single straight line is a linestring with a single segment.

```
SELECT NEW ST_LineString('LineString(0 0,1 1,2 2,3 3)').ST_ConvexHull()
```

ST_ConvexHullAggr method for type ST_Geometry

Returns the convex hull for all of the geometries in a group

Syntax

ST_Geometry::**ST_ConvexHullAggr**(*geometry-column*)

Parameters

Name	Type	Description
geometry-column	ST_Geometry	The geometry values to generate the convex hull. Typically this is a column.

Returns

- **ST_Geometry** Returns the convex hull for all the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_ConvexHullAggr considers all of the points in the group of geometries it is computed over and returns the convex hull of all these points. The convex hull of a geometry is the smallest convex geometry that contains all of the points in the geometry.

The convex hull may be visualized by imagining an elastic band stretched to enclose all of the points in the geometry. When released, the elastic band takes the shape of the convex hull.

If the geometries in the group consist of a single point, the point is returned. If all of the points of the group of geometries lie on a single straight line segment, a linestring is returned. Otherwise, a convex polygon is returned.

The convex hull can serve as an approximation of the original geometry. When testing a spatial relationship, the convex hull can serve as a quick pre-filter because if there is no spatial intersection with the convex hull then there can be no intersection with the original geometry.

Note
ST_ConvexHullAggr is not supported on geometries which contain circular strings.

Note
This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_ConvexHull method for type ST_Geometry" on page 138

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon ((3 0, 7 2, 3 6, 0 7, -3 6, -3 3, 0 0, 3 0))`.

```
SELECT ST_Geometry::ST_ConvexHullAggr( Shape )
FROM SpatialShapes WHERE ShapeID <= 16
```

ST_CoordDim method for type ST_Geometry

Returns the number of coordinate dimensions stored with each point of the ST_Geometry value.

Syntax

geometry-expression.**ST_CoordDim**()

Returns

- **SMALLINT** Returns a value between 2 and 4 indicating the number of coordinate dimensions stored with each point of the ST_Geometry value.

Remarks

The ST_CoordDim method returns the number of coordinates stored within each point in the geometry. All geometries have at least two coordinate dimensions. For geographic spatial reference systems, these are the latitude and longitude of the point. For other spatial reference system, these coordinates are the X and Y positions of the point.

Geometries can optionally have Z and M values associated with each of the points in the geometry. These additional coordinate values are not considered when computing spatial relations or set operations, but they can be used to record additional information. For example, the measure value (M) can be used to record the pollution at various points within a geometry. The Z value usually is used to indicate elevation, but that interpretation is not imposed by the database server.

The following values may be returned by the ST_CoordDim method:

- **2** The geometry contains only two coordinates (either latitude/longitude or X/Y).
- **3** The geometry contains one additional coordinate (either Z or M) for each point.
- **4** The geometry contains two additional coordinate (both Z and M) for each point.

> **Note**
> Spatial operations that combine geometries using set operations do not preserve any Z or M values associated with the points of the geometry.

> **Note**
> By default, ST_CoordDim uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_Is3D method for type ST_Geometry" on page 168
- "ST_IsMeasured method for type ST_Geometry" on page 169

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.3

Example

The following example returns the result 2.

```
SELECT NEW ST_Point(1.0, 1.0).ST_CoordDim()
```

The following example returns the result 3.

```
SELECT NEW ST_Point(1.0, 1.0, 1.0, 0).ST_CoordDim()
```

The following example returns the result 3.

```
SELECT NEW ST_Point('Point M (1 1 1)' ).ST_CoordDim()
```

The following example returns the result 4.

```
SELECT NEW ST_Point('Point ZM (1 1 1 1)' ).ST_CoordDim()
```

ST_CoveredBy method for type ST_Geometry

Tests if a geometry value is spatially covered by another geometry value.

Syntax

geometry-expression.**ST_CoveredBy**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* covers *geo2*, otherwise 0.

Remarks

The ST_CoveredBy method tests if the *geometry-expression* is completely covered by *geo2*.

geometry-expression.ST_CoveredBy(*geo2*) is equivalent to *geo2*.ST_Covers(*geometry-expression*).

This predicate is similar to ST_Within except for one subtle difference. The ST_Within predicate requires that one or more interior points of the *geometry-expression* lie in the interior of *geo2*. For ST_CoveredBy(), the method returns 1 if no point of the *geometry-expression* lies outside of *geo2*, regardless of whether interior points of the two geometries intersect. ST_CoveredBy can be used with geometries in round-Earth spatial reference systems.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- “ST_Covers method for type ST_Geometry” on page 144
- “ST_Within method for type ST_Geometry” on page 211
- “ST_Intersects method for type ST_Geometry” on page 165
- “ST_CoveredByFilter method for type ST_Geometry” on page 143

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example tests if a point is covered by a polygon. The point is completely covered by the polygon so the example returns 1.

```
SELECT NEW ST_Point( 1, 1 )
    .ST_CoveredBy( NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' ) )
```

The following example tests if a line is covered by a polygon. The line is completely covered by the polygon so the example returns 1. If ST_Within was used in place of ST_CoveredBy, ST_Within would return 0.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 1 0 )' )
    .ST_CoveredBy( NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' ) )
```

The following example lists the ShapeIDs where the given point is within the Shape geometry. This example returns the result `3,5,6`. Note that ShapeID 6 is listed even though the point intersects that row's Shape polygon only at the polygon's boundary.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE NEW ST_Point( 1, 4 ).ST_CoveredBy( Shape ) = 1
```

ST_CoveredByFilter method for type ST_Geometry

A cheap test if a geometry might possibly be covered by another.

Syntax

geometry-expression.**ST_CoveredByFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* might be covered by *geo2*, otherwise 0.

Remarks

The ST_CoveredByFilter method provides an efficient test to determine if one geometry might be covered by the other. Returns 1 if the *geometry-expression* might cover *geo2*, otherwise 0.

This test is cheaper than ST_CoveredBy, but may return 1 in some cases where the *geometry-expression* is not actually covered by *geo2*.

Therefore, this method can be useful as a primary filter when further processing will determine whether geometries interact in the desired way.

The implementation of ST_CoveredByFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_CoveredByFilter is used within a query, the expression *geometry-expression*.ST_CoveredByFilter(*geo2*) can return different results when *geometry-expression* is not covered by *geo2*. Whenever *geometry-expression* is covered by *geo2*, ST_CoveredByFilter will always return 1.

See also

- "ST_CoveredBy method for type ST_Geometry" on page 142

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_Covers method for type ST_Geometry

Tests if a geometry value spatially covers another geometry value.

Syntax

geometry-expression.**ST_Covers**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* covers *geo2*, otherwise 0.

Remarks

The ST_Covers method tests if the *geometry-expression* completely covers *geo2*. *geometry-expression*.ST_Covers(*geo2*) is equivalent to *geo2*.ST_CoveredBy(*geometry-expression*).

This predicate is similar to ST_Contains except for one subtle difference. The ST_Contains predicate requires that one or more interior points of *geo2* lie in the interior of the *geometry-expression*. For ST_Covers(), the method returns 1 if no point of *geo2* lies outside of the *geometry-expression*. Also, ST_Covers can be used with geometries in round-Earth spatial reference systems, while ST_Contains can not.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_CoveredBy method for type ST_Geometry" on page 142
- "ST_Contains method for type ST_Geometry" on page 135
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_CoversFilter method for type ST_Geometry" on page 145

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example tests if a polygon covers a point. The polygon completely covers the point so the example returns 1.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' )
    .ST_Covers( NEW ST_Point( 1, 1 ) )
```

The following example tests if a polygon covers a line. The polygon completely covers the line so the example returns 1. If ST_Contains was used in place of ST_Covers, ST_Contains would return 0.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' )
    .ST_Covers( NEW ST_LineString( 'LineString( 0 0, 1 0 )' ) )
```

The following example lists the ShapeIDs where the given polygon covers each Shape geometry. This example returns the result `1,16,17,19,26`. Note that ShapeID 1 is listed even though the polygon intersects that row's Shape point only at the polygon's boundary.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE NEW ST_Polygon( NEW ST_Point( 0, 0 ),
                      NEW ST_Point( 8, 2 ) ).ST_Covers( Shape ) = 1
```

ST_CoversFilter method for type ST_Geometry

A cheap test if a geometry might possibly cover another.

Syntax

geometry-expression.**ST_CoversFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* might cover *geo2*, otherwise 0.

Remarks

The ST_CoversFilter method provides an efficient test to determine if one geometry might cover the other. Returns 1 if the *geometry-expression* might cover *geo2*, otherwise 0.

This test is cheaper than ST_Covers, but may return 1 in some cases where the *geometry-expression* does not actually cover *geo2*.

Therefore, this method can be useful as a primary filter when further processing will determine whether geometries interact in the desired way.

The implementation of ST_CoversFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_CoversFilter is used within a query, the expression *geometry-expression*.ST_CoversFilter(*geo2*) can return different results when *geometry-expression* does not cover *geo2*. Whenever *geometry-expression* covers *geo2*, ST_CoversFilter will always return 1.

See also

- "ST_Covers method for type ST_Geometry" on page 144

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_Crosses method for type ST_Geometry

Tests if a geometry value crosses another geometry value.

Syntax

geometry-expression.**ST_Crosses**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* crosses *geo2*, otherwise 0. Returns NULL if *geometry-expression* is a surface or multisurface if or *geo2* is a point or multipoint.

Remarks

Tests if a geometry value crosses another geometry value.

When both *geometry-expression* and *geo2* are curves or multicurves, they cross each other if their interiors intersect at one or more points. If the intersection results in a curve or multicurve, the geometries do not cross. If all of the intersecting points are boundary points, the geometries do not cross.

When *geometry-expression* has lower dimension than *geo2*, then *geometry-expression* crosses *geo2* if part of *geometry-expression* is on the interior of *geo2* and part of *geometry-expression* is on the exterior of *geo2*.

More precisely, *geometry-expression*.ST_Crosses(*geo2*) returns 1 when the following is TRUE:

```
( geometry-expression.ST_Dimension() = 1
  AND geo2.ST_Dimension() = 1
  AND geometry-expression.ST_Relate( geo2, '0********' ) = 1 )
OR( geometry-expression.ST_Dimension() < geo2.ST_Dimension()
  AND geometry-expression.ST_Relate( geo2, 'T*T******' ) = 1 )
```

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

Note
This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_Dimension method for type ST_Geometry" on page 149
- "ST_Relate method for type ST_Geometry" on page 181
- "ST_Overlaps method for type ST_Geometry" on page 180

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.29

Example

The following example returns the result `1`.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 2 2 )' )
        .ST_Crosses( NEW ST_LineString( 'LineString( 0 2, 2 0 )' ) )
```

The following examples returns the result `0` because the interiors of the two lines do not intersect (the only intersection is at the first linestring boundary).

```
SELECT NEW ST_LineString( 'LineString( 0 1, 2 1 )' )
        .ST_Crosses( NEW ST_LineString( 'LineString( 0 0, 2 0 )' ) )
```

The following example returns NULL because the first geometry is a surface.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 0 1, 1 0, 0 0))' )
        .ST_Crosses( NEW ST_LineString( 'LineString( 0 0, 2 0 )' ) )
```

ST_Difference method for type ST_Geometry

Returns the geometry value that represents the point set difference of two geometries.

Syntax

geometry-expression.**ST_Difference**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be subtracted from the *geometry-expression*.

Returns

- **ST_Geometry** Returns the geometry value that represents the point set difference of two geometries.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_Difference method finds the spatial difference of two geometries. A point is included in the result if it is present in the *geometry-expression* but not present in *geo2*.

Unlike other spatial set operations (ST_Union, ST_Intersection, ST_SymDifference), the ST_Difference() method is not symmetric: the method can give a different answer for `A.ST_Difference( B )` and `B.ST_Difference( A )`.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_Intersection method for type ST_Geometry" on page 163
- "ST_SymDifference method for type ST_Geometry" on page 190
- "ST_Union method for type ST_Geometry" on page 209

Standards and compatibility

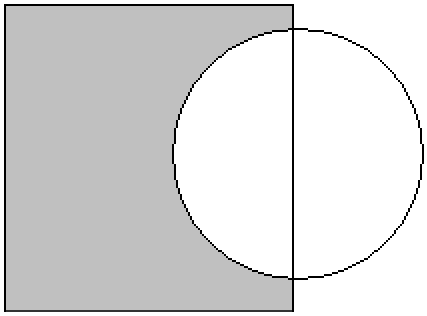
- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.20

Example

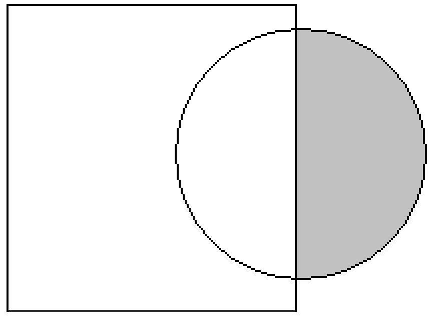
The following example shows the difference (C) of a square (A) with a circle (B) removed and the difference (D) of a circle (B) with a square (A) removed.

```
SELECT NEW ST_Polygon( 'Polygon( (-1 -0.25, 1 -0.25, 1 2.25, -1 2.25, -1
-0.25) )' ) AS A
     , NEW ST_CurvePolygon( 'CurvePolygon( CircularString( 0 1, 1 2, 2 1, 1 0,
0 1 ) )' )  AS B
     , A.ST_Difference( B ) AS C
     , B.ST_Difference( A ) AS D
```

The following picture shows the difference C=A-B and D=B-A as the shaded portion of the picture. Each difference is a single surface that contains all of the points that are in the geometry on the left hand side of the difference and not in the geometry on the right hand side.



C



D

ST_Dimension method for type ST_Geometry

Returns the dimension of the ST_Geometry value. Points have dimension 0, lines have dimension 1, and surfaces have dimension 2. Any empty geometry has dimension -1.

Syntax

geometry-expression.**ST_Dimension**()

Returns

- **SMALLINT** Returns the dimension of the *geometry-expression* as a SMALLINT between -1 and 2.

Remarks

The ST_Dimension method returns the spatial dimension occupied by a geometry. The following values may be returned:

- **-1** The geometry corresponds to the empty set.
- **0** The geometry consists only of individual points (for example, an ST_Point or ST_MultiPoint).
- **1** The geometry contains at least one curve and no surfaces (for example, an ST_LineString or ST_MultiCurve).
- **2** The geometry consists of at least one surface (for example, an ST_Polygon or ST_MultiPolygon).

When computing the dimension of a collection, the largest dimension of any element is returned. For example, if a geometry collection contains a curve and a point, ST_Dimension returns 1 for the collection.

See "Additional information on the ST_Dimension method" on page 43.

Note
By default, ST_Dimension uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_CoordDim method for type ST_Geometry” on page 140
- “ST_Relate method for type ST_Geometry” on page 181
- “ST_Relate method for type ST_Geometry” on page 181

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.2

Example

The following example returns the result `0`.

```
SELECT NEW ST_Point(1.0,1.0).ST_Dimension()
```

The following example returns the result `1`.

```
SELECT NEW ST_LineString('LineString( 0 0, 1 1)' ).ST_Dimension()
```

ST_Disjoint method for type ST_Geometry

Test if a geometry value is spatially disjoint from another value.

Syntax

geometry-expression.**ST_Disjoint**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* is spatially disjoint from *geo2*, otherwise 0.

Remarks

Tests if a geometry value is spatially disjoint from another value. Two geometries are disjoint if their intersection is empty. In other words, they are disjoint if there is no point anywhere in *geometry-expression* that is also in *geo2*."

geometry-expression.ST_Disjoint(*geo2*) = 1 is equivalent to *geometry-expression*.ST_Intersects(*geo2*) = 0.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_Intersects method for type ST_Geometry" on page 165

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.26

Example

The following example returns a result with one row for each shape that has no points in common with the specified triangle.

```
SELECT ShapeID, "Description"
FROM SpatialShapes
WHERE NEW ST_Polygon( 'Polygon((0 0, 5 0, 0 5, 0 0))' ).ST_Disjoint( Shape )
= 1
ORDER BY ShapeID
```

The example returns the following result set:

ShapeID	Description
1	Point
22	Triangle

ST_Distance method for type ST_Geometry

Returns the smallest distance between the *geometry-expression* and the specified geometry value.

Syntax

geometry-expression.**ST_Distance**(*geo2*[, *unit-name*])

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value whose distance is to be measured from the *geometry-expression*.
unit-name	VARCHAR(128)	The units in which the distance should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the smallest distance between the *geometry-expression* and *geo2* in the specified linear units of measure. If either *geometry-expression* or *geo2* is empty, then NULL is returned.

Remarks

The ST_Distance method computes the shortest distance between two geometries. For planar spatial reference systems, the distance is calculated as the Cartesian distance within the plane, computed in the linear units of measure for the associated spatial reference system. For round-Earth spatial reference systems, the distance is computed taking the curvature of the Earth's surface into account using the ellipsoid parameters in the spatial reference system definition.

> **Note**
> For round-Earth spatial reference systems, the ST_Distance method is only supported if *geometry-expression* and *geo2* contain only points.

> **Note**
> By default, ST_Distance uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_Area method for type ST_Surface" on page 289
- "ST_Length method for type ST_Curve" on page 72
- "ST_Perimeter method for type ST_Surface" on page 290
- "ST_WithinDistance method for type ST_Geometry" on page 212
- "ST_WithinDistanceFilter method for type ST_Geometry" on page 214

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.23

Example

The following example returns an ordered result set with one row for each shape and the corresponding distance from the point (2,3).

```
SELECT ShapeID, ROUND( Shape.ST_Distance( NEW ST_Point( 2, 3 ) ), 2 ) AS dist
FROM SpatialShapes
WHERE ShapeID < 17
ORDER BY dist
```

The example returns the following result set:

ShapeID	dist
2	0.0
3	0.0
5	1.0
6	1.21

ShapeID	dist
16	1.41
1	5.1

The following example creates points representing Halifax, NS and Waterloo, ON, Canada and uses ST_Distance to find the distance between the two points in miles, returning the result 846. This example assumes that the 'st_geometry_predefined_uom' feature has been installed by the "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

```
SELECT ROUND( NEW ST_Point( -63.573566, 44.646244, 4326 )
    .ST_Distance( NEW ST_Point( -80.522372, 43.465187, 4326 )
                        , 'Statute mile' ), 0 )
```

ST_Envelope method for type ST_Geometry

Returns the bounding rectangle for the geometry value.

Syntax

geometry-expression.**ST_Envelope**()

Returns

- **ST_Polygon** Returns a polygon that is the bounding rectangle for the *geometry-expression*.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_Envelope method constructs a polygon that is an axis-aligned bounding rectangle for the *geometry-expression*. The envelope covers the entire geometry, and it can be used as a simple approximation for the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_EnvelopeAggr method for type ST_Geometry" on page 154

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.15

Example

The following example returns the result `Polygon ((0 0, 1 0, 1 4, 0 4, 0 0))`.

```
SELECT Shape.ST_Envelope()
FROM SpatialShapes WHERE ShapeID = 6
```

ST_EnvelopeAggr method for type ST_Geometry

Returns the bounding rectangle for all of the geometries in a group

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

Syntax

ST_Geometry::**ST_EnvelopeAggr**(*geometry-column*)

Parameters

Name	Type	Description
geometry-column	ST_Geometry	The geometry values to generate the bounding rectangle. Typically this is a column.

Returns

- **ST_Polygon** Returns a polygon that is the bounding rectangle for all the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

See also

- "ST_Envelope method for type ST_Geometry" on page 153

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon ((-3 -1, 8 -1, 8 8, -3 8, -3 -1))`.

```
SELECT ST_Geometry::ST_EnvelopeAggr( Shape ) FROM SpatialShapes
```

ST_Equals method for type ST_Geometry

Tests if an ST_Geometry value is spatially equal to another ST_Geometry value.

Syntax

geometry-expression.**ST_Equals**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the two geometry values are spatially equal, otherwise 0.

Remarks

Tests if an ST_Geometry value is equal to another ST_Geometry value.

The test for spatial equality is performed by first comparing the bounding rectangles of the two geometries. If they are not equal within tolerance, the two geometries are considered not to be equal, and 0 is returned. Otherwise, the database server returns 1 if `geometry-expression.ST_SymDifference( geo2 )` is the empty set, otherwise it returns 0.

Note that the SQL/MM standard defines ST_Equals only in terms of ST_SymDifference, without an additional bounding box comparison. There are some geometries that generate an empty result with ST_SymDifference while their bounding boxes are not equal. These geometries would be considered equal by the SQL/MM standard but are not considered equal by SQL Anywhere. This difference can arise if the one or both geometries contain spikes or punctures.

Two geometry values can be considered equal even though they have different representations. For example, two linestrings may be have opposite orientations but contain the same set of points in space. These two linestrings are considered equal by ST_Equals but not by ST_OrderingEquals. See "Comparing geometries using ST_Equals and ST_OrderingEquals" on page 15.

ST_Equals may be limited by the resolution of the spatial reference system or the accuracy of the data.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_OrderingEquals method for type ST_Geometry" on page 178
- "ST_EqualsFilter method for type ST_Geometry" on page 156

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.24

Example

The following example returns the result `16`. The Shape corresponding to ShapeID the result `16` contains the same points but in a different order as the specified polygon.

```
SELECT ShapeID FROM SpatialShapes
WHERE Shape.ST_Equals( NEW ST_Polygon( 'Polygon ((2 0, 1 2, 0 0, 2 0))' ) ) =
1
```

The following example returns the result `1`, indicating that the two linestrings are equal even though they contain a different number of points specified in a different order, and the intermediate point is not exactly on the line. The intermediate point is about 3.33e-7 away from the line with only two points, but that distance less than the tolerance 1e-6 for the "Default" spatial reference system (SRID 0).

```
SELECT NEW ST_LineString( 'LineString( 0 0, 0.333333 1, 1 3 )' )
        .ST_Equals( NEW ST_LineString( 'LineString( 1 3, 0 0 )' ) )
```

ST_EqualsFilter method for type ST_Geometry

A cheap test if a geometry is equal to another.

Syntax

geometry-expression.**ST_EqualsFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to *geometry-expression*.

Returns

- **BIT** Returns 1 if the bounding box for *geometry-expression* is equal, within tolerance, to the bounding box for *geo2*, otherwise 0.

Remarks

The ST_EqualsFilter method provides an efficient test to determine if a geometry might be equal to another. ST_EqualsFilter returns 1 if *geometry-expression* might be equal to *geo2*; otherwise ST_EqualsFilter returns 0.

This test is cheaper than ST_Equals, but can return 1 in some cases where the *geometry-expression* is not actually equal to *geo2*.

Therefore, This method can be useful as a primary filter when further processing will determine whether geometries interact in the desired way.

The implementation of ST_EqualsFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_EqualsFilter is used within a query, the expression *geometry-expression*.ST_EqualsFilter(*geo2*) can return different results when *geometry-expression* does not equal *geo2*. Whenever *geometry-expression* equals *geo2*, ST_EqualsFilter will always return 1.

See also

- "ST_Equals method for type ST_Geometry" on page 154
- "ST_OrderingEquals method for type ST_Geometry" on page 178

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_GeomFromBinary method for type ST_Geometry

Constructs a geometry from a binary string representation.

Syntax

ST_Geometry::**ST_GeomFromBinary**(*binary-string*[, *srid*])

Parameters

Name	Type	Description
binary-string	LONG BINARY	A string containing the binary representation of a geometry. The input can be in any supported binary format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified and the input string does not provide a SRID, the default is 0.

Returns

- **ST_Geometry** Returns a geometry value of the appropriate type based on the source string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

Parses a string containing one of the supported formats and creates a geometry value of the appropriate type. This method is used by the server when evaluating a cast from a binary string to a geometry type.

Some input formats contain an SRID definition. If provided, the *srid* parameter must match any value taken from the input string.

See also

- "ST_GeomFromWKB method for type ST_Geometry" on page 159
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Point (10 20)`.

```
SELECT
ST_Geometry::ST_GeomFromBinary( 0x0101000000000000000000244000000000000003440
)
```

ST_GeomFromShape method for type ST_Geometry

Parses a string containing an ESRI shape record and creates a geometry value of the appropriate type.

Syntax

ST_Geometry::**ST_GeomFromShape**(*shape*[, *srid*])

Parameters

Name	Type	Description
shape	LONG BINARY	A string containing a geometry in the ESRI shape format.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns a geometry value of the appropriate type based on the source string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

Parses a string containing a single ESRI shape and creates a geometry value of the appropriate type. The record is a single record from the *.shp* file of an ESRI shapefile or it could be a single string value from a geodatabase.

The Shape representation is widely used to represent spatial data. For a full description of the shape definition, see the ESRI website, http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf.

In most cases it is easier to load an ESRI shapefile using the SHAPEFILE format with the FORMAT clause of the LOAD TABLE statement, or an OPENSTRING expression in a FROM clause instead of using the ST_GeomFromShape method. See "LOAD TABLE statement" [*SQL Anywhere Server - SQL Reference*], and "FROM clause" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_GeomFromText method for type ST_Geometry

Constructs a geometry from a character string representation.

Syntax

ST_Geometry::**ST_GeomFromText**(*character-string*[, *srid*])

Parameters

Name	Type	Description
character-string	LONG VARCHAR	A string containing the text representation of a geometry. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified and the input string does not contain a SRID, the default is 0.

Returns

- **ST_Geometry** Returns a geometry value of the appropriate type based on the source string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

Parses a text string representing a geometry and creates a geometry value of the appropriate type. This method is used by the server when evaluating a cast from a character string to a geometry type.

The server detects the format of the input string. Some input formats contain an SRID definition. If provided, the *srid* parameter must match any value taken from the input string.

See also

- "ST_GeomFromBinary method for type ST_Geometry" on page 157
- "ST_GeomFromWKT method for type ST_Geometry" on page 160

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.40

Example

The following example returns the result `LineString (1 2, 5 7)`.

```
SELECT ST_Geometry::ST_GeomFromText( 'LineString( 1 2, 5 7 )', 4326 )
```

ST_GeomFromWKB method for type ST_Geometry

Parse a string containing a WKB or EWKB representation of a geometry and creates a geometry value of the appropriate type.

Syntax

ST_Geometry::**ST_GeomFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the WKB or EWKB representation of a geometry value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns a geometry value of the appropriate type based on the source string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

Parses a string containing the WKB or EWKB representation of a geometry value and creates a geometry value of the appropriate type.

See also

- "ST_GeomFromBinary method for type ST_Geometry" on page 157
- "ST_GeomFromWKT method for type ST_Geometry" on page 160

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.41

ST_GeomFromWKT method for type ST_Geometry

Parses a string containing the WKT or EWKT representation of a geometry and create a geometry value of the appropriate type.

Syntax

ST_Geometry::**ST_GeomFromWKT**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	A string containing the WKT or EWKT representation of a geometry value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns a geometry value of the appropriate type based on the source string.

The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

Parses a string containing the WKT or EWKT representation of a geometry value and creates a geometry value of the appropriate type.

See also

- "ST_GeomFromText method for type ST_Geometry" on page 158
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_GeometryType method for type ST_Geometry

Returns the name of the type of the ST_Geometry value.

Syntax

geometry-expression.**ST_GeometryType**()

Returns

- **VARCHAR(128)** Returns the data type of the geometry value as a text string. This method can be used to determine the dynamic type of a value.

Remarks

The ST_GeometryType method returns a string containing the specific type name of *geometry-expression*.

The value IS OF(type) syntax can also be used to determined the specific type of a value.

> **Note**
> By default, ST_GeometryType uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.4

Example

The following returns the result `2,3,6,16,22,24,25`, which is the list of ShapeIDs whose corresponding Shape is one of the specified types.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE Shape.ST_GeometryType() IN( 'ST_Polygon', 'ST_CurvePolygon' )
```

ST_GeometryTypeFromBaseType method for type ST_Geometry

Parses a string defining the type string.

Syntax

ST_Geometry::**ST_GeometryTypeFromBaseType**(*base-type-str*)

Parameters

Name	Type	Description
base-type-str	VARCHAR(128)	A string containing the base type string

Returns

- **VARCHAR(128)** Returns the geometry type from a base type string (which may include an SRID definition). If the type string is not a valid geometry type string, an error is returned.

Remarks

The *ST_Geometry::ST_GeometryTypeFromBaseType* method can be used to parse the geometry type name out of a type string definition.

See also

- "ST_SRIDFromBaseType method for type ST_Geometry" on page 187

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `ST_Geometry`.

```
SELECT ST_Geometry::ST_GeometryTypeFromBaseType('ST_Geometry')
```

The following example returns the result `ST_Point`.

```
SELECT ST_Geometry::ST_GeometryTypeFromBaseType('ST_Point(SRID=4326)')
```

The following example finds the geometry type (ST_Point) accepted by a stored procedure parameter.

```
CREATE PROCEDURE myprocedure( parm1 ST_Point(SRID=0) )
BEGIN
   -- ...
END;

SELECT    parm_name nm, base_type_str,
ST_Geometry::ST_GeometryTypeFromBaseType(base_type_str) geom_type
FROM    sysprocedure KEY JOIN sysprocparm
WHERE    proc_name='myprocedure' and parm_name='parm1'
```


ST_Intersection method for type ST_Geometry

Returns the geometry value that represents the point set intersection of two geometries.

Syntax

geometry-expression.**ST_Intersection**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be intersected with the *geometry-expression*.

Returns

- **ST_Geometry** Returns the geometry value that represents the point set intersection of two geometries.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_Intersection method finds the spatial intersection of two geometries. A point is included in the intersection if it is present in both of the input geometries. If the two geometries don't share any common points, the result is an empty geometry.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_Difference method for type ST_Geometry" on page 147
- "ST_IntersectionAggr method for type ST_Geometry" on page 164
- "ST_SymDifference method for type ST_Geometry" on page 190
- "ST_Union method for type ST_Geometry" on page 209

Standards and compatibility

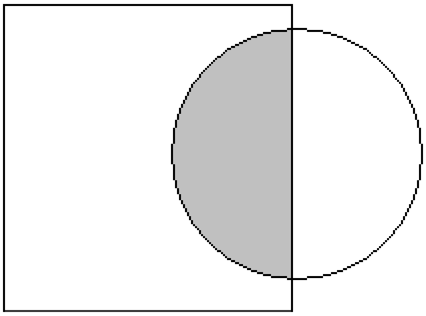
- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.18

Example

The following example shows the intersection (C) of a square (A) and a circle (B).

```
SELECT NEW ST_Polygon( 'Polygon( (-1 -0.25, 1 -0.25, 1 2.25, -1 2.25, -1
-0.25) )' ) AS A
    , NEW ST_CurvePolygon( 'CurvePolygon( CircularString( 0 1, 1 2, 2 1, 1 0,
0 1 ) )' )  AS B
    , A.ST_Intersection( B ) AS C
```

The intersection is shaded in the following picture. It is a single surface that includes all of the points that are in the square and also in the circle.



ST_IntersectionAggr method for type ST_Geometry

Returns the spatial intersection of all of the geometries in a group

Syntax

ST_Geometry::**ST_IntersectionAggr**(*geometry-column*)

Parameters

Name	Type	Description
geometry-column	ST_Geometry	The geometry values to generate the spatial intersection. Typically this is a column.

Returns

- **ST_Geometry** Returns a geometry that is the spatial intersection for all the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

If the group contains a single non-NULL geometry, it is returned. Otherwise, the intersection is logically computed by repeatedly applying the ST_Intersection method to combine two geometries at a time. See "ST_Intersection method for type ST_Geometry" on page 163.

See also

- "ST_Intersection method for type ST_Geometry" on page 163

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon ((0 0, 1 2, .5 2, .75 3, .555555 3, 0 1.75, .5 1.75, 0 0))`.

```
SELECT ST_Geometry::ST_IntersectionAggr( Shape )
FROM SpatialShapes WHERE ShapeID IN ( 2, 6 )
```

ST_Intersects method for type ST_Geometry

Test if a geometry value spatially intersects another value.

Syntax

geometry-expression.**ST_Intersects**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* spatially intersects with *geo2*, otherwise 0.

Remarks

Tests if a geometry value spatially intersects another value. Two geometries intersect if they share one or more common points.

geometry-expression.ST_Intersects(*geo2*) = 1 is equivalent to *geometry-expression*.ST_Disjoint(*geo2*) = 0.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_IntersectsRect method for type ST_Geometry" on page 167
- "ST_Disjoint method for type ST_Geometry" on page 150
- "ST_IntersectsFilter method for type ST_Geometry" on page 166

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.27

Example

The following example returns a result with one row for each shape that intersects the specified line.

```
SELECT ShapeID, "Description"
FROM SpatialShapes
```

```
WHERE NEW ST_LineString( 'LineString( 2 2, 4 4 )' ).ST_Intersects( Shape ) =
1
ORDER BY ShapeID
```

The example returns the following result set:

ShapeID	Description
2	Square
3	Rectangle
5	L shape line
18	CircularString
22	Triangle

To visualize how the geometries in the SpatialShapes table intersect the line in the above example, execute the following query in the Interactive SQL Spatial Viewer.

```
SELECT Shape
FROM SpatialShapes
WHERE NEW ST_LineString( 'LineString( 2 2, 4 4 )' ).ST_Intersects( Shape ) =
1
UNION ALL SELECT NEW ST_LineString( 'LineString( 2 2, 4 4 )' )
```

ST_IntersectsFilter method for type ST_Geometry

A cheap test if the two geometries might possibly intersect.

Syntax

geometry-expression.**ST_IntersectsFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* might intersect with *geo2*, otherwise 0.

Remarks

The ST_IntersectsFilter method provides an efficient test to determine if two geometries might possibly intersect. Returns 1 if the *geometry-expression* might intersect with *geo2*, otherwise 0.

This test is cheaper than ST_Intersects, but may return 1 in some cases where the geometries do not actually intersect. Therefore, this method can be useful as a primary filter when further processing will determine if geometries truly intersect.

The implementation of ST_IntersectsFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_IntersectsFilter is used within a query, the expression *geometry-expression*.ST_IntersectsFilter(*geo2*) can return different results when *geometry-expression* does not intersect *geo2*. Whenever *geometry-expression* intersects *geo2*, ST_IntersectsFilter will always return 1.

See also

- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_IntersectsRect method for type ST_Geometry" on page 167

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_IntersectsRect method for type ST_Geometry

Test if a geometry intersects a rectangle.

Syntax

geometry-expression.**ST_IntersectsRect**(*pmin*,*pmax*)

Parameters

Name	Type	Description
pmin	ST_Point	The minimum point value that is to be compared to the *geometry-expression*.
pmax	ST_Point	The maximum point value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* intersects with the specified rectangle, otherwise 0.

Remarks

The ST_IntersectsRect method tests if a geometry intersects with a specified axis-aligned bounding rectangle.

The method is equivalent to the following: *geometry-expression*.ST_Intersects(NEW ST_Polygon(pmin, pmax))

Therefore, this method can be useful for writing window queries to find all geometries that intersect a given axis-aligned rectangle.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_IntersectsFilter method for type ST_Geometry" on page 166

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example lists the ShapeIDs where the rectangle specified by the envelope of the two points intersects the corresponding Shape geometry. This example returns the result `3,5,6,18`.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE Shape.ST_IntersectsRect( NEW ST_Point( 0, 4 ), NEW ST_Point( 2, 5 ) ) =
1
```

The following example tests if a linestring intersects a rectangle. The provided linestring does not intersect the rectangle identified by the two points (even though the envelope of the linestring does intersect the envelope of the two points).

```
SELECT NEW ST_LineString( 'LineString( 0 0, 10 0, 10 10 )' )
        .ST_IntersectsRect( NEW ST_Point( 4, 4 ) , NEW ST_Point( 6, 6 ) )
```

ST_Is3D method for type ST_Geometry

Determines if the geometry value has Z coordinate values.

> **Note**
> By default, ST_Is3D uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

geometry-expression.**ST_Is3D**()

Returns

- **BIT** Returns 1 if the geometry value has Z coordinate values, otherwise 0.

See also

- "ST_CoordDim method for type ST_Geometry" on page 140
- "ST_IsMeasured method for type ST_Geometry" on page 169

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.10

Example

The following example returns the result `1`.

```
SELECT ShapeID FROM SpatialShapes WHERE Shape.ST_Is3D() = 1
```

ST_IsEmpty method for type ST_Geometry

Determines whether the geometry value represents an empty set.

Syntax

geometry-expression.**ST_IsEmpty**()

Returns

- **BIT** Returns 1 if the geometry value is empty, otherwise 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.7

Example

The following example returns the result `1`.

```
SELECT NEW ST_LineString().ST_IsEmpty()
```

ST_IsMeasured method for type ST_Geometry

Determines if the geometry value has associated measure values.

> **Note**
> By default, ST_IsMeasured uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

Syntax

geometry-expression.**ST_IsMeasured**()

Returns

- **BIT** Returns 1 if the geometry value has measure values, otherwise 0.

See also

- "ST_CoordDim method for type ST_Geometry" on page 140
- "ST_Is3D method for type ST_Geometry" on page 168

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.11

Example

The following example returns the result `1`.

```
SELECT ST_Geometry::ST_GeomFromText( 'LineString M( 1 2 4, 5 7
3 )' ).ST_IsMeasured()
```

The following example returns the result `0`.

```
SELECT count(*) FROM SpatialShapes WHERE Shape.ST_IsMeasured() = 1
```

ST_IsSimple method for type ST_Geometry

Determines whether the geometry value is simple (containing no self intersections or other irregularities).

Syntax

geometry-expression.**ST_IsSimple**()

Returns

- **BIT** Returns 1 if the geometry value is simple, otherwise 0.

See also

- "ST_IsValid method for type ST_Geometry" on page 170

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.8

Example

The following returns the result `29` because the corresponding multi linestring contains two lines which cross.

```
SELECT ShapeID FROM SpatialShapes WHERE Shape.ST_IsSimple() = 0
```

ST_IsValid method for type ST_Geometry

Determines whether the geometry is a valid spatial object.

Syntax

geometry-expression.**ST_IsValid**()

Returns

- **BIT** Returns 1 if the geometry value is valid, otherwise 0.

Remarks

By default, the server does not validate spatial data as it is created or imported from other formats. The ST_IsValid method can be used to verify that the imported data represents a geometry that is valid. Operations on invalid geometries return undefined results.

See also

- "ST_IsSimple method for type ST_Geometry" on page 170

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.9

Example

The following returns the result `0` because the polygon contains a bow tie (the ring has a self-intersection).

```
SELECT ST_Geometry::ST_GeomFromText( 'Polygon(( 0 0, 4 0, 4 5, 0 -1, 0
0 ))' )
        .ST_IsValid()
```

The following returns the result `0` because the polygons within the geometry self-intersect at a surface. Note that self-intersections of a geometry collection at finite number of points is considered valid.

```
SELECT ST_Geometry::ST_GeomFromText(
                'MultiPolygon((( 0 0, 2 0, 1 2, 0 0 )),((0 2, 1 0, 2 2, 0 2)))' )
                        .ST_IsValid()
```

ST_LatNorth method for type ST_Geometry

Retrieves the northernmost latitude of a geometry.

Syntax

geometry-expression.**ST_LatNorth**()

Returns

- **DOUBLE** Returns the northernmost latitude of the *geometry-expression*.

Remarks

Returns the northernmost latitude value of the *geometry-expression*. Note that in the round-Earth model, the northernmost latitude may not correspond to the latitude of any of the points defining the geometry.

Note
If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_LatNorth uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_LatSouth method for type ST_Geometry" on page 172
- "ST_LongEast method for type ST_Geometry" on page 175
- "ST_LongWest method for type ST_Geometry" on page 176
- "ST_YMax method for type ST_Geometry" on page 219

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `49.74`.

```
SELECT ROUND( NEW ST_LineString( 'LineString( -122 49, -96 49 )', 4326 )
                .ST_LatNorth(), 2 )
```

ST_LatSouth method for type ST_Geometry

Retrieves the southernmost latitude of a geometry.

Syntax

geometry-expression.**ST_LatSouth**()

Returns

- **DOUBLE** Returns the southernmost latitude of the *geometry-expression*.

Remarks

Returns the southernmost latitude value of the *geometry-expression*. Note that in the round-Earth model, the southernmost latitude may not correspond to the latitude of any of the points defining the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_LatSouth uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_LatNorth method for type ST_Geometry” on page 171
- “ST_LongEast method for type ST_Geometry” on page 175
- “ST_LongWest method for type ST_Geometry” on page 176
- “ST_YMin method for type ST_Geometry” on page 220

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 49.

```
SELECT ROUND( NEW ST_LineString( 'LineString( -122 49, -96 49 )', 4326 )
                .ST_LatSouth(), 2 )
```

ST_LinearHash method for type ST_Geometry

Returns a binary string that is a linear hash of the geometry.

Syntax

geometry-expression.**ST_LinearHash**()

Returns

- **BINARY(32)** Returns a binary string that is a linear hash of the geometry.

Remarks

The spatial index support uses a linear hash for geometries that maps the geometries in a table into a linear order in a B-Tree index. The ST_LinearHash method exposes this mapping by returning a binary string that gives the ordering of the rows in the B-Tree index. The hash string provides the following property: if geometry *A* covers geometry *B*, then `A.ST_LinearHash() >= B.ST_LinearHash()`.

The linear hash can be used in an ORDER BY clause. For example, when unloading data from a SELECT statement, ST_LinearHash can be used to generate a data file that matches the clustering of a spatial index.

See also

- “ST_LinearUnHash method for type ST_Geometry” on page 173

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_LinearUnHash method for type ST_Geometry

Returns a geometry representing the index hash.

Syntax

ST_Geometry::**ST_LinearUnHash**(*index-hash*[, *srid*])

Parameters

Name	Type	Description
index-hash	BINARY(32)	The index hash string.
srid	INT	The SRID of the index hash. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns a representative geometry for the given linear hash.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

The ST_LinearUnHash method generates a representative geometry for a linear hash string generated by ST_LinearHash(). The server maps geometries to a linear order for spatial indexes, and the ST_LinearHash method gives a binary string that defines this linear ordering. The ST_LinearUnHash reverses this operation to give a geometry that represents a particular hash string. The hash operation is lossy in the sense that multiple distinct geometries may hash to the same binary string. The ST_LinearUnHash method returns a geometry that covers any geometry that maps to the given linear hash.

The graphical plan for a query that uses a spatial index shows the linear hash values used to probe the spatial index. The ST_LinearUnHash method can be used to generate a geometry that represents these hashes.

See also

- "ST_LinearHash method for type ST_Geometry" on page 173

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_LoadConfigurationData method for type ST_Geometry

Returns binary configuration data. For internal use only.

Syntax

ST_Geometry::**ST_LoadConfigurationData**(*configuration-name*)

Parameters

Name	Type	Description
configuration-name	VARCHAR(128)	The name of the configuration data item to load.

Returns

- **LONG BINARY** Returns binary configuration data. For internal use only.

Remarks

This method is used by the server to load configuration data from installed files. If the configuration files are not installed with the server, NULL is returned. For internal use only.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_LongEast method for type ST_Geometry

Retrieves the longitude of the eastern boundary of a geometry.

Syntax

geometry-expression.**ST_LongEast**()

Returns

- **DOUBLE** Retrieves the longitude of the eastern boundary of the *geometry-expression*.

Remarks

Returns the longitude of the eastern boundary of the *geometry-expression*. If the geometry crosses the date line in the round-Earth model, ST_LongWest will be higher than the ST_LongEast value.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_LongEast uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_LongWest method for type ST_Geometry" on page 176
- "ST_LatNorth method for type ST_Geometry" on page 171
- "ST_LatSouth method for type ST_Geometry" on page 172
- "ST_XMax method for type ST_Geometry" on page 217

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `-157.8`.

```
SELECT NEW ST_LineString( 'LineString( -157.8 21.3, 144.5 13 )', 4326 )
                .ST_LongEast()
```

ST_LongWest method for type ST_Geometry

Retrieves the longitude of the western boundary of a geometry.

Syntax

geometry-expression.**ST_LongWest**()

Returns

- **DOUBLE** Retrieves the longitude of the western boundary of the *geometry-expression*.

Remarks

Returns the longitude of the western boundary of the *geometry-expression*. If the geometry crosses the date line in the round-Earth model, ST_LongWest will be higher than the ST_LongEast value.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_LongWest uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_LongEast method for type ST_Geometry" on page 175
- "ST_LatNorth method for type ST_Geometry" on page 171
- "ST_LatSouth method for type ST_Geometry" on page 172
- "ST_XMin method for type ST_Geometry" on page 218

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `144.5`.

```
SELECT NEW ST_LineString( 'LineString( -157.8 21.3, 144.5 13 )', 4326 )
                .ST_LongWest()
```


ST_MMax method for type ST_Geometry

Retrieves the maximum M coordinate value of a geometry.

Syntax

geometry-expression.**ST_MMax**()

Returns

- **DOUBLE** Returns the maximum M coordinate value of the *geometry-expression*.

Remarks

Returns the maximum M coordinate value of the *geometry-expression*. This is computed by comparing the M attribute of all points in the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_MMax uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMin method for type ST_Geometry" on page 218
- "ST_XMax method for type ST_Geometry" on page 217
- "ST_YMin method for type ST_Geometry" on page 220
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMin method for type ST_Geometry" on page 222
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMin method for type ST_Geometry" on page 177

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 8.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_MMax()
```

ST_MMin method for type ST_Geometry

Retrieves the minimum M coordinate value of a geometry.

Syntax

geometry-expression.**ST_MMin**()

Returns

- **DOUBLE** Returns the minimum M coordinate value of the *geometry-expression*.

Remarks

Returns the minimum M coordinate value of the *geometry-expression*. This is computed by comparing the M attribute of all points in the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_MMin uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMin method for type ST_Geometry" on page 218
- "ST_XMax method for type ST_Geometry" on page 217
- "ST_YMin method for type ST_Geometry" on page 220
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMin method for type ST_Geometry" on page 222
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMax method for type ST_Geometry" on page 177

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 4.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_MMin()
```

ST_OrderingEquals method for type ST_Geometry

Tests if a geometry is identical to another geometry.

Syntax

geometry-expression.**ST_OrderingEquals**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the two geometry values are exactly equal, otherwise 0.

Remarks

Tests if an ST_Geometry value is identical to another ST_Geometry value. The two geometries must contain the same hierarchy of objects with the exact same points in the same order to be considered equal under ST_OrderingEquals.

The ST_OrderingEquals method differs from ST_Equals in that it considers the orientation of curves. Two curves can contain exactly the same points but in opposite orders. These two curves are considered equal with ST_Equals but unequal with ST_OrderingEquals. Additionally, ST_OrderingEquals requires that each point in both geometries is exactly equal, not just equal within the tolerance-distance specified by the spatial reference system.

The ST_OrderingEquals method defines the semantics used for comparison predicates (= and <>), IN list predicates, DISTINCT, and GROUP BY. If you wish to compare if two spatial values are spatially equal (contain the same set of points in set), you can use the ST_Equals method.

For more information, see "Comparing geometries using ST_Equals and ST_OrderingEquals" on page 15.

> **Note**
> The SQL/MM standard defines ST_OrderingEquals to return a relative ordering, with 0 returned if two geometries are spatially equal (according to ST_Equals) and 1 if they are not equal. The SQL Anywhere implementation follows industry practice and differs from SQL/MM in that it returns a boolean with 1 indicating the geometries are equal and 0 indicating they are different. Further, the ST_OrderingEquals implementation differs from SQL/MM because it tests that values are identical (same hierarchy of objects in the same order) instead of spatially equal (same set of points in space).

See also

- "ST_Equals method for type ST_Geometry" on page 154

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.43

Example

The following example returns the result `16`. The Shape corresponding to ShapeID the result `16` contains the exact same points in the exact same order as the specified polygon.

```
SELECT ShapeID FROM SpatialShapes
WHERE Shape.ST_OrderingEquals( NEW ST_Polygon( 'Polygon ((0 0, 2 0, 1 2, 0
0))' ) ) = 1
```

ST_Overlaps method for type ST_Geometry

Tests if a geometry value overlaps another geometry value.

Syntax

geometry-expression.**ST_Overlaps**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* overlaps *geo2*, otherwise 0. Returns NULL if *geometry-expression* and *geo2* have different dimensions.

Remarks

Two geometries overlap if the following conditions are all true:

- Both geometries have the same dimension.
- The intersection of *geometry-expression* and *geo2* geometries has the same dimension as *geometry-expression*.
- Neither of the original geometries is a subset of the other.

More precisely, *geometry-expression*.ST_Overlaps(*geo2*) returns 1 when the following is TRUE:

```
geometry-expression.ST_Dimension() = geo2.ST_Dimension()
AND geometry-expression.ST_Intersection( geo2 ).ST_Dimension() = geometry-
expression.ST_Dimension()
AND geometry-expression.ST_Covers( geo2 ) = 0
AND geo2.ST_Covers( geometry-expression ) = 0
```

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

Note
This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Dimension method for type ST_Geometry" on page 149
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_Covers method for type ST_Geometry" on page 144
- "ST_Crosses method for type ST_Geometry" on page 146

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.32

Example

The following returns the result `1` since the intersection of the two linestrings is also a linestring, and neither geometry is a subset of the other.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 5 0 )' )
        .ST_Overlaps( NEW ST_LineString( 'LineString( 2 0, 3 0, 3 3 )' ) )
```

The following returns the result `NULL` since the linestring and point have different dimension.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 5 0 )' )
        .ST_Overlaps( NEW ST_Point( 1, 0 ) )
```

The following returns the result `0` since the point is a subset of the multipoint.

```
SELECT NEW ST_MultiPoint( 'MultiPoint(( 2 3 ), ( 1 0 ))' )
        .ST_Overlaps( NEW ST_Point( 1, 0 ) )
```

The following returns the result `24,25,28,31`, which is the list of ShapeIDs that overlap the specified polygon.

```
SELECT LIST( ShapeID ORDER BY ShapeID ) FROM SpatialShapes
WHERE Shape.ST_Overlaps( NEW ST_Polygon( 'Polygon(( -1 0, 0 0, 0 1, -1 1, -1
0 ))' )
                       ) = 1
```

ST_Relate method for type ST_Geometry

Tests if a geometry value is spatially related to another geometry value as specified by the intersection matrix. The ST_Relate method uses a 9-character string from the Dimensionally Extended 9 Intersection Model (DE-9IM) to describe the pair-wise relationship between two spatial data items. For example, the ST_Relate method determines if an intersection occurs between the geometries, and the geometry of the resulting intersection, if it exists. See also: "Test custom relationships using the ST_Relate method" on page 44.

Overload list

Name	Description
"ST_Relate(ST_Geometry,CHAR(9)) method for type ST_Geometry" on page 182	Tests if a geometry value is spatially related to another geometry value as specified by the intersection matrix. The ST_Relate method uses a 9-character string from the Dimensionally Extended 9 Intersection Model (DE-9IM) to describe the pair-wise relationship between two spatial data items. For example, the ST_Relate method determines if an intersection occurs between the geometries, and the geometry of the resulting intersection, if it exists.

Name	Description
"ST_Relate(ST_Geometry) method for type ST_Geometry" on page 183	Determines how a geometry value is spatially related to another geometry value by returning an intersection matrix. The ST_Relate method returns a 9-character string from the Dimensionally Extended 9 Intersection Model (DE-9IM) to describe the pair-wise relationship between two spatial data items. For example, the ST_Relate method determines if an intersection occurs between the geometries, and the geometry of the resulting intersection, if it exists.

ST_Relate(ST_Geometry,CHAR(9)) method for type ST_Geometry

Tests if a geometry value is spatially related to another geometry value as specified by the intersection matrix. The ST_Relate method uses a 9-character string from the Dimensionally Extended 9 Intersection Model (DE-9IM) to describe the pair-wise relationship between two spatial data items. For example, the ST_Relate method determines if an intersection occurs between the geometries, and the geometry of the resulting intersection, if it exists.

Syntax

geometry-expression.**ST_Relate**(*geo2*,*relate-matrix*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The second geometry value that is to be compared to the *geometry-expression*.
relate-matrix	CHAR(9)	A 9-character string representing a matrix in the dimensionally-extended 9 intersection model. Each character defined in the 9-character string represents the type of intersection allowed at one of the nine possible intersections between the interior, boundary, and exterior of the two geometries.

Returns

- **BIT** Returns 1 if the two geometries have the specified relationship; otherwise 0.

Remarks

Tests if a geometry value is spatially related to another geometry value by testing for intersection between the interior, boundary, and exterior of two geometries, as specified by the intersection matrix. See also: "Test custom relationships using the ST_Relate method" on page 44.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

Note
This method can not be used with geometries in round-Earth spatial reference system.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.25

Example

The following example returns a result with one row for each shape that has the '0F***T***' relationship with the specified line. The '0' means the interiors of both geometries must intersect and result in a point or multipoint. The 'F' means the interior of the line and the boundary of Shape must not intersect. The 'T' means the exterior of the line and the interior of the Shape must intersect.

```
SELECT ShapeID, "Description" From SpatialShapes
WHERE NEW ST_LineString( 'LineString( 0 0, 10 0 )' )
    .ST_Relate( Shape, '0F****T**' ) = 1
ORDER BY ShapeID
```

The example returns the following result set:

ShapeID	Description
18	CircularString
30	Multicurve

ST_Relate(ST_Geometry) method for type ST_Geometry

Determines how a geometry value is spatially related to another geometry value by returning an intersection matrix. The ST_Relate method returns a 9-character string from the Dimensionally Extended 9 Intersection Model (DE-9IM) to describe the pair-wise relationship between two spatial data items. For example, the ST_Relate method determines if an intersection occurs between the geometries, and the geometry of the resulting intersection, if it exists.

Syntax

geometry-expression.**ST_Relate**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The second geometry value that is to be compared to the *geometry-expression*.

Returns

- **CHAR(9)** Returns A 9-character string representing a matrix in the dimensionally-extended 9 intersection model. Each character in the 9-character string represents the type of intersection at one of the nine possible intersections between the interior, boundary, and exterior of the two geometries.

Remarks

Tests if a geometry value is spatially related to another geometry value by testing for intersection between the interior, boundary, and exterior of two geometries, as specified by the intersection matrix.

The intersection matrix is returned as a string. While it is possible to use this method variant to test a spatial relationship by examining the returned string, it is more efficient to test relationships by passing a pattern string as second parameter or by using specific spatial predicates such as ST_Contains or ST_Intersects. See also: "Test custom relationships using the ST_Relate method" on page 44.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `1F2001102`.

```
SELECT NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 0 2, 0 0 ))' )
    .ST_Relate( NEW ST_LineString( 'LineString( 0 1, 5 1 )' ) )
```

ST_Reverse method for type ST_Geometry

Returns the geometry with the element order reversed.

Syntax

geometry-expression.**ST_Reverse**()

Returns

- **ST_Geometry** Returns the geometry with the element order reversed.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Returns the geometry with the order of its elements reversed. For a curve, a curve is returned with the vertices in the opposite order. For a collection, a collection is returned with the child geometries in the reversed order.

> **Note**
> By default, ST_Reverse uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `LineString (3 4, 1 2)`. It shows how the order of points in a linestring is reversed by ST_Reverse.

```
SELECT NEW ST_LineString( NEW ST_Point(1,2), NEW ST_Point(3,4) ).ST_Reverse()
```

ST_SRID method for type ST_Geometry

Retrieves or modifies the spatial reference system associated with the geometry value.

Overload list

Name	Description
"ST_SRID() method for type ST_Geometry" on page 185	Returns the SRID of the geometry.
"ST_SRID(INT) method for type ST_Geometry" on page 186	Changes the spatial reference system associated with the geometry without modifying any of the values.

ST_SRID() method for type ST_Geometry

Returns the SRID of the geometry.

Syntax

geometry-expression.**ST_SRID**()

Returns

- **INT** Returns the SRID of the geometry.

Remarks

Returns the SRID of the geometry. Every geometry is associated with a spatial reference system.

> **Note**
> By default, ST_SRID uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.5

Example

The following returns the result `0`, indicating all Shapes in the table have the SRID 0, corresponding to the 'Default' spatial reference system.

```
SELECT DISTINCT Shape.ST_SRID() FROM SpatialShapes
```

ST_SRID(INT) method for type ST_Geometry

Changes the spatial reference system associated with the geometry without modifying any of the values.

Syntax

geometry-expression.**ST_SRID**(*srid*)

Parameters

Name	Type	Description
srid	INT	The SRID to use for the result.

Returns

- **ST_Geometry** Returns a copy of the geometry value with the specified spatial reference system.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

The ST_SRID method creates a copy of a *geometry-expression* with the SRID specified by srid parameter. ST_SRID can be used when both the source and destination spatial reference systems have the same coordinate system.

If you are transforming a geometry between two spatial reference systems that have different coordinate systems, you should use the ST_Transform method.

Note
By default, ST_SRID uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_Transform method for type ST_Geometry" on page 208

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.5

Example

The following example returns the result `SRID=1000004326;Point (-118 34)`.


```
SELECT NEW ST_Point( -118, 34,
4326 ).ST_SRID( 1000004326 ).ST_AsText( 'EWKT' )
```

ST_SRIDFromBaseType method for type ST_Geometry

Parses a string defining the type string.

Syntax

ST_Geometry::**ST_SRIDFromBaseType**(*base-type-str*)

Parameters

Name	Type	Description
base-type-str	VARCHAR(128)	A string containing the base type string

Returns

- **INT** Returns the SRID from a type string. If no SRID is specified by the string, returns NULL. If the type string is not a valid geometry type string, an error is returned.

Remarks

The *ST_Geometry::ST_SRIDFromBaseType* method can be used to parse the SRID out of a type string definition.

See also

- "ST_GeometryTypeFromBaseType method for type ST_Geometry" on page 162

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `NULL`.

```
SELECT ST_Geometry::ST_SRIDFromBaseType('ST_Geometry')
```

The following example returns the result `4326`.

```
SELECT ST_Geometry::ST_SRIDFromBaseType('ST_Geometry(SRID=4326)')
```

ST_SnapToGrid method for type ST_Geometry

Returns a copy of the geometry with all points snapped to the specified grid.

Overload list

Name	Description
"ST_SnapToGrid(DOUBLE) method for type ST_Geometry" on page 188	Returns a copy of the geometry with all points snapped to the specified grid.
"ST_SnapToGrid(ST_Point,DOUBLE,DOUBLE,DOUBLE,DOUBLE) method for type ST_Geometry" on page 189	Returns a copy of the geometry with all points snapped to the specified grid.

ST_SnapToGrid(DOUBLE) method for type ST_Geometry

Returns a copy of the geometry with all points snapped to the specified grid.

Syntax

geometry-expression.**ST_SnapToGrid**(*cell-size*)

Parameters

Name	Type	Description
cell-size	DOUBLE	The cell size for the grid.

Returns

- **ST_Geometry** Returns the geometry with all points snapped to the grid.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_SnapToGrid method can be used to reduce the precision of data by snapping all points in a geometry to a grid defined by the origin and cell size.

The X and Y coordinates are snapped to the grid; any Z and M values are unchanged.

Note
Reducing precision may cause the resulting geometry to have different properties. For example, it may cause a simple linestring to cross itself, or it may generate an invalid geometry.

Note
Each spatial reference system defines a grid that all geometries are automatically snapped to. You can not store more precision than this predefined grid.

Note
By default, ST_SnapToGrid uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_SnapToGrid(ST_Point,DOUBLE,DOUBLE,DOUBLE,DOUBLE) method for type ST_Geometry

Returns a copy of the geometry with all points snapped to the specified grid.

Syntax

geometry-expression.**ST_SnapToGrid**(*origin*,*cell-size-x*,*cell-size-y*,*cell-size-z*,*cell-size-m*)

Parameters

Name	Type	Description
origin	ST_Point	The origin of the grid.
cell-size-x	DOUBLE	The cell size for the grid in the X dimension.
cell-size-y	DOUBLE	The cell size for the grid in the Y dimension.
cell-size-z	DOUBLE	The cell size for the grid in the Z dimension.
cell-size-m	DOUBLE	The cell size for the grid in the M dimension.

Returns

- **ST_Geometry** Returns the geometry with all points snapped to the grid.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_SnapToGrid method can be used to reduce the precision of data by snapping all points in a geometry to a grid defined by an origin and cell size.

You can specify a different cell size for each dimension. If you do not wish to snap the points of one dimension, you can use a cell size of zero.

Note
Reducing precision may cause the resulting geometry to have different properties. For example, it may cause a simple linestring to cross itself, or it may generate an invalid geometry.

Note
Each spatial reference system defines a grid that all geometries are automatically snapped to. You can not store more precision than this predefined grid.

Note
By default, ST_SnapToGrid uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "How snap-to-grid and tolerance impact spatial calculations" on page 8

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `LineString(1.010101 20.20202, 1.015625 20.203125, 1.01 20.2)`.

```
SELECT NEW ST_LineString(
   NEW ST_Point( 1.010101, 20.202020 ),
   TREAT( NEW ST_Point( 1.010101, 20.202020 ).ST_SnapToGrid( NEW
ST_Point( 0.0, 0.0 ), POWER( 2, -6 ), POWER( 2, -7 ), 0.0, 0.0 ) AS
ST_Point ),
   TREAT( NEW ST_Point( 1.010101, 20.202020 ).ST_SnapToGrid( NEW
ST_Point( 1.01, 20.2 ), POWER( 2, -6 ), POWER( 2, -7 ), 0.0, 0.0 ) AS
ST_Point ) )
```

The first point of the linestring is the point ST_Point(1.010101, 20.202020), snapped to the grid defined for SRID 0.

The second point of the linestring is the same point snapped to a grid defined with its origin at point (0.0 0.0), where cell size x is POWER(2, -6) and cell size y is POWER(2, -7).

The third point of the linestring is the same point snapped to a grid defined with its origin at point (1.01, 20.2), where cell size x is POWER(2, -6) and cell size y is POWER(2, -7).

ST_SymDifference method for type ST_Geometry

Returns the geometry value that represents the point set symmetric difference of two geometries.

Syntax

geometry-expression.**ST_SymDifference**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be subtracted from the *geometry-expression* to find the symmetric difference.

Returns

- **ST_Geometry** Returns the geometry value that represents the point set symmetric difference of two geometries.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_SymDifference method finds the symmetric difference of two geometries. The symmetric difference consists of all of those points that are in only one of the two geometries. If the two geometry values consist of the same points, the ST_SymDifference method returns an empty geometry.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- "ST_Difference method for type ST_Geometry" on page 147
- "ST_Intersection method for type ST_Geometry" on page 163
- "ST_Union method for type ST_Geometry" on page 209

Standards and compatibility

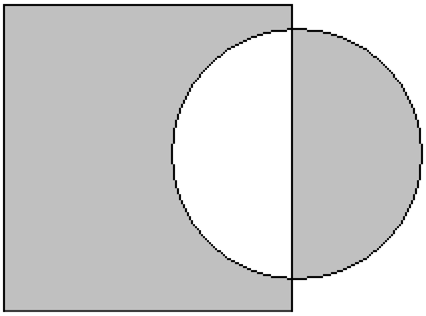
- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.21

Example

The following example shows the symmetric difference (C) of a square (A) and a circle (B).

```
SELECT NEW ST_Polygon( 'Polygon( (-1 -0.25, 1 -0.25, 1 2.25, -1 2.25, -1
-0.25) )' ) AS A
    , NEW ST_CurvePolygon( 'CurvePolygon( CircularString( 0 1, 1 2, 2 1, 1 0,
0 1 ) )' )  AS B
    , A.ST_SymDifference( B ) AS C
```

The following picture shows the result of the symmetric difference as the shaded portion of the picture. The symmetric difference is a multisurface that includes two surfaces: one surface contains all of the points from the square that are not in the circle, and the other surface contains all of the points of the circle that are not in the square.



ST_ToCircular method for type ST_Geometry

Convert the geometry to a circular string

Syntax

geometry-expression.**ST_ToCircular**()

Returns

- **ST_CircularString** If the *geometry-expression* is of type ST_CircularString, return the *geometry-expression*. If the *geometry-expression* is of type ST_CompoundCurve with a single element which is of type ST_CircularString, return that element. If the *geometry-expression* is a geometry collection with a single element of type ST_CircularString, return that element. If the *geometry-expression* is the empty set, return an empty set of type ST_CircularString. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Convert this geometry to a circular string. The logic is equivalent to that used for CAST(*geometry-expression* AS ST_CircularString).

If *geometry-expression* is already known to be an ST_CircularString value, it is more efficient to use TREAT(*geometry-expression* AS ST_CircularString) than the ST_ToCircular method.

> **Note**
> By default, ST_ToCircular uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToCompound method for type ST_Geometry" on page 193
- "ST_ToCurve method for type ST_Geometry" on page 194
- "ST_ToLineString method for type ST_Geometry" on page 197
- "ST_ToMultiCurve method for type ST_Geometry" on page 198

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `CircularString (0 0, 1 1, 2 0)`.

```
SELECT NEW ST_CompoundCurve( 'CompoundCurve(CircularString( 0 0, 1 1, 2
0 ))' ).ST_ToCircular()
```

ST_ToCompound method for type ST_Geometry

Converts the geometry to a compound curve.

Syntax

geometry-expression.**ST_ToCompound**()

Returns

- **ST_CompoundCurve** If the *geometry-expression* is of type ST_CompoundCurve, return the *geometry-expression*. If the *geometry-expression* is of type ST_LineString or ST_CircularString, return a compound curve containing one element, the *geometry-expression*. If the *geometry-expression* is a geometry collection with a single element of type ST_Curve, return that element cast as ST_CompoundCurve. If the *geometry-expression* is the empty set, return an empty set of type ST_CompoundCurve. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Converts the geometry to a circular string. The logic is equivalent to that used for CAST(*geometry-expression* AS ST_CompoundCurve).

If *geometry-expression* is already known to be an ST_CompoundCurve value, it is more efficient to use TREAT(*geometry-expression* AS ST_CompoundCurve) than the ST_ToCompound method.

Note
By default, ST_ToCompound uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_ToCircular method for type ST_Geometry” on page 192
- “ST_ToCurve method for type ST_Geometry” on page 194
- “ST_ToLineString method for type ST_Geometry” on page 197
- “ST_ToMultiCurve method for type ST_Geometry” on page 198

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `CompoundCurve ((0 0, 2 1))`.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 2 1 )' ).ST_ToCompound()
```

ST_ToCurve method for type ST_Geometry

Converts the geometry to a curve.

Syntax

geometry-expression.**ST_ToCurve**()

Returns

- **ST_Curve** If the *geometry-expression* is of type ST_Curve, return the *geometry-expression*. If the *geometry-expression* is a geometry collection with a single element of type ST_Curve, return that element. If the *geometry-expression* is the empty set, return an empty set of type ST_LineString. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Converts the geometry to a curve. The logic is equivalent to that used for **CAST(** *geometry-expression* **AS ST_Curve)**.

If *geometry-expression* is already known to be an ST_Curve value, it is more efficient to use TREAT(*geometry-expression* AS ST_Curve) than the ST_ToCurve method.

> **Note**
> By default, ST_ToCurve uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToCircular method for type ST_Geometry" on page 192
- "ST_ToCompound method for type ST_Geometry" on page 193
- "ST_ToLineString method for type ST_Geometry" on page 197
- "ST_ToMultiCurve method for type ST_Geometry" on page 198

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `LineString (0 0, 1 1, 2 0)`.

```
SELECT NEW ST_GeomCollection( 'GeometryCollection(LineString(0 0, 1 1, 2
0))' ).ST_ToCurve()
```

ST_ToCurvePoly method for type ST_Geometry

Converts the geometry to a curve polygon.

Syntax

geometry-expression.**ST_ToCurvePoly**()

Returns

- **ST_CurvePolygon** If the *geometry-expression* is of type ST_CurvePolygon, return the *geometry-expression*. If the *geometry-expression* is a geometry collection with a single element of type ST_CurvePolygon, return that element. If the *geometry-expression* is the empty set, return an empty set of type ST_CurvePolygon. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_CurvePolygon value, it is more efficient to use TREAT(*geometry-expression* AS ST_CurvePolygon) than the ST_ToCurvePoly method.

> **Note**
> By default, ST_ToCurvePoly uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToPolygon method for type ST_Geometry" on page 204
- "ST_ToSurface method for type ST_Geometry" on page 206
- "ST_ToMultiSurface method for type ST_Geometry" on page 202

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `Polygon ((0 0, 2 0, 1 2, 0 0))`.

```
SELECT NEW ST_MultiPolygon('MultiPolygon(((0 0, 2 0, 1 2, 0
0)))' ).ST_ToCurvePoly()
```

ST_ToGeomColl method for type ST_Geometry

Converts the geometry to a geometry collection.

Syntax

geometry-expression.**ST_ToGeomColl**()

Returns

- **ST_GeomCollection** If the *geometry-expression* is of type ST_GeomCollection, returns the *geometry-expression*. If the *geometry-expression* is of type ST_Point, ST_Curve, or ST_Surface, then return a geometry collection containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_GeomCollection. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_GeomCollection value, it is more efficient to use TREAT(*geometry-expression* AS ST_GeomCollection) than the ST_ToGeomColl method.

> **Note**
> By default, ST_ToGeomColl uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiCurve method for type ST_Geometry" on page 198
- "ST_ToMultiPoint method for type ST_Geometry" on page 200
- "ST_ToMultiSurface method for type ST_Geometry" on page 202

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `GeometryCollection (Point (0 1))`.

```
SELECT NEW ST_Point( 0, 1 ).ST_ToGeomColl()
```

ST_ToLineString method for type ST_Geometry

Converts the geometry to a linestring.

Syntax

geometry-expression.**ST_ToLineString**()

Returns

- **ST_LineString** If the *geometry-expression* is of type ST_LineString, return the *geometry-expression*. If the *geometry-expression* is of type ST_CircularString or ST_CompoundCurve, return *geometry-expression*.ST_CurveToLine(). If the *geometry-expression* is a geometry collection with a single element of type ST_Curve, return that element cast as ST_LineString. If the *geometry-expression* is the empty set, return an empty set of type ST_LineString. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Converts the geometry to a linestring. The logic is equivalent to that used for CAST(*geometry-expression* AS ST_LineString). If the *geometry-expression* is a circular string or compound curve, it is approximated using ST_CurveToLine().

If *geometry-expression* is already known to be an ST_LineString value, it is more efficient to use TREAT(*geometry-expression* AS ST_LineString) than the ST_ToLineString method.

Note
By default, ST_ToLineString uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiLine method for type ST_Geometry" on page 199
- "ST_ToCircular method for type ST_Geometry" on page 192
- "ST_ToCompound method for type ST_Geometry" on page 193
- "ST_ToCurve method for type ST_Geometry" on page 194
- "ST_CurveToLine method for type ST_Curve" on page 70

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following returns an error because the Shape column is of type ST_Geometry and ST_Geometry does not support the ST_Length method.

```
SELECT Shape.ST_Length()
FROM SpatialShapes WHERE ShapeID = 5
```

The following uses ST_ToLineString to change the type of the Shape column expression to ST_LineString. ST_Length returns the result 7.

```
SELECT Shape.ST_ToLineString().ST_Length()
FROM SpatialShapes WHERE ShapeID = 5
```

In this case, the value of the Shape column is known be of type ST_LineString, so TREAT can be used to efficiently change the type of the expression. ST_Length returns the result 7.

```
SELECT TREAT( Shape AS ST_LineString ).ST_Length()
FROM SpatialShapes WHERE ShapeID = 5
```

ST_ToMultiCurve method for type ST_Geometry

Converts the geometry to a multicurve value.

Syntax

geometry-expression.**ST_ToMultiCurve**()

Returns

- **ST_MultiCurve** If the *geometry-expression* is of type ST_MultiCurve, returns the *geometry-expression*. If the *geometry-expression* is a geometry collection containing only curves, returns a multicurve object containing the elements of the *geometry-expression*. If the *geometry-expression* is of type ST_Curve then return a multicurve value containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_MultiCurve. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_MultiCurve value, it is more efficient to use TREAT(*geometry-expression* AS ST_MultiCurve) than the ST_ToMultiCurve method.

> **Note**
> By default, ST_ToMultiCurve uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiLine method for type ST_Geometry" on page 199
- "ST_ToGeomColl method for type ST_Geometry" on page 196
- "ST_ToCurve method for type ST_Geometry" on page 194

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `MultiCurve ((0 7, 0 4, 4 4))`.

```
SELECT Shape.ST_ToMultiCurve()
FROM SpatialShapes WHERE ShapeID = 5
```

ST_ToMultiLine method for type ST_Geometry

Converts the geometry to a multilinestring value.

Syntax

geometry-expression.**ST_ToMultiLine**()

Returns

- **ST_MultiLineString** If the *geometry-expression* is of type ST_MultiLineString, returns the *geometry-expression*. If the *geometry-expression* is a geometry collection containing only lines, returns a multilinestring object containing the elements of the *geometry-expression*. If the *geometry-expression* is of type ST_LineString then return a multilinestring value containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_MultiCurve. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_MultiLineString value, it is more efficient to use TREAT(*geometry-expression* AS ST_MultiLineString) than the ST_ToMultiLine method.

Note
By default, ST_ToMultiLine uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiCurve method for type ST_Geometry" on page 198
- "ST_ToGeomColl method for type ST_Geometry" on page 196
- "ST_ToLineString method for type ST_Geometry" on page 197

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following returns an error because the Shape column is of type ST_Geometry and ST_Geometry does not support the ST_Length method.

```
SELECT Shape.ST_Length()
FROM SpatialShapes WHERE ShapeID = 29
```

The following uses ST_ToMultiLine to change the type of the Shape column expression to ST_MultiLineString. This example would also work with ShapeID 5, where the Shape value is of type ST_LineString. ST_Length returns the result `4.236068`.

```
SELECT Shape.ST_ToMultiLine().ST_Length()
FROM SpatialShapes WHERE ShapeID = 29
```

In this case, the value of the Shape column is known be of type ST_MultiLineString, so TREAT can be used to efficiently change the type of the expression. This example would **not** work with ShapeID 5, where the Shape value is of type ST_LineString. ST_Length returns the result `4.236068`.

```
SELECT TREAT( Shape AS ST_MultiLineString ).ST_Length()
FROM SpatialShapes WHERE ShapeID = 29
```

ST_ToMultiPoint method for type ST_Geometry

Converts the geometry to a multi-point value.

Syntax

geometry-expression.**ST_ToMultiPoint**()

Returns

- **ST_MultiPoint** If the *geometry-expression* is of type ST_MultiPoint, returns the *geometry-expression*. If the *geometry-expression* is a geometry collection containing only points, returns a multipoint object containing the elements of the *geometry-expression*. If the *geometry-expression* is of type ST_Point then return a multi-point value containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_MultiPoint. Otherwise, raises an exception condition.

The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_MultiPoint value, it is more efficient to use TREAT(*geometry-expression* AS ST_MultiPoint) than the ST_ToMultiPoint method.

> **Note**
> By default, ST_ToMultiPoint uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToGeomColl method for type ST_Geometry" on page 196
- "ST_ToPoint method for type ST_Geometry" on page 203

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `MultiPoint EMPTY`.

```
SELECT NEW ST_GeomCollection().ST_ToMultiPoint().ST_AsText()
```

ST_ToMultiPolygon method for type ST_Geometry

Converts the geometry to a multi-polygon value.

Syntax

geometry-expression.**ST_ToMultiPolygon**()

Returns

- **ST_MultiPolygon** If the *geometry-expression* is of type ST_MultiPolygon, returns the *geometry-expression*. If the *geometry-expression* is a geometry collection containing only polygons, returns a multi-polygon object containing the elements of the *geometry-expression*. If the *geometry-expression* is of type ST_Polygon then return a multi-polygon value containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_MultiSurface. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_MultiPolygon value, it is more efficient to use TREAT(*geometry-expression* AS ST_MultiPolygon) than the ST_ToMultiPolygon method.

> **Note**
> By default, ST_ToMultiPolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiSurface method for type ST_Geometry" on page 202
- "ST_ToGeomColl method for type ST_Geometry" on page 196
- "ST_ToPolygon method for type ST_Geometry" on page 204

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `MultiPolygon EMPTY`.

```
SELECT NEW ST_GeomCollection().ST_ToMultiPolygon().ST_AsText()
```

The following returns an error because the Shape column is of type ST_Geometry and ST_Geometry does not support the ST_Area method.

```
SELECT Shape.ST_Area()
FROM SpatialShapes WHERE ShapeID = 27
```

The following uses ST_ToMultiPolygon to change the type of the Shape column expression to ST_MultiPolygon. This example would also work with ShapeID 22, where the Shape value is of type ST_LineString. ST_Area returns the result `8`.

```
SELECT Shape.ST_ToMultiPolygon().ST_Area()
FROM SpatialShapes WHERE ShapeID = 27
```

In this case, the value of the Shape column is known be of type ST_MultiPolygon, so TREAT can be used to efficiently change the type of the expression. This example would **not** work with ShapeID 22, where the Shape value is of type ST_Polygon. ST_Area returns the result `8`.

```
SELECT TREAT( Shape AS ST_MultiPolygon ).ST_Area()
FROM SpatialShapes WHERE ShapeID = 27
```

ST_ToMultiSurface method for type ST_Geometry

Converts the geometry to a multi-surface value.

Syntax

geometry-expression.**ST_ToMultiSurface**()

Returns

- **ST_MultiSurface** If the *geometry-expression* is of type ST_MultiSurface, returns the *geometry-expression*. If the *geometry-expression* is a geometry collection containing only surfaces, returns a multi-surface object containing the elements of the *geometry-expression*. If the *geometry-expression* is of type ST_Surface then return a multi-surface value containing one element, the *geometry-expression*. If the *geometry-expression* is the empty set, returns an empty set of type ST_MultiSurface. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

If *geometry-expression* is already known to be an ST_MultiSurface value, it is more efficient to use TREAT(*geometry-expression* AS ST_MultiSurface) than the ST_ToMultiSurface method.

> **Note**
> By default, ST_ToMultiSurface uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiPolygon method for type ST_Geometry" on page 201
- "ST_ToGeomColl method for type ST_Geometry" on page 196
- "ST_ToSurface method for type ST_Geometry" on page 206

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `MultiSurface EMPTY`.

```
SELECT NEW ST_GeomCollection().ST_ToMultiSurface()
```

The following example returns the result `MultiSurface (((3 3, 8 3, 4 8, 3 3)))`.

```
SELECT Shape.ST_ToMultiSurface()
FROM SpatialShapes WHERE ShapeID = 22
```

ST_ToPoint method for type ST_Geometry

Converts the geometry to a point.

Syntax

geometry-expression.**ST_ToPoint**()

Returns

- **ST_Point** If the *geometry-expression* is of type ST_Point, return the *geometry-expression*. If the *geometry-expression* is a geometry collection with a single element of type ST_Point, return that element. If the *geometry-expression* is the empty set, return an empty set of type ST_Point. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Converts the geometry to a point. The logic is equivalent to that used for **CAST(** *geometry-expression* **AS ST_Point)**.

If *geometry-expression* is already known to be an ST_Point value, it is more efficient to use TREAT(*geometry-expression* AS ST_Point) than the ST_ToPoint method.

> **Note**
> By default, ST_ToPoint uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToMultiPoint method for type ST_Geometry" on page 200

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `Point (1 2)`.

```
SELECT NEW ST_GeomCollection( NEW ST_Point(1,2) ).ST_ToPoint().ST_AsText()
```

ST_ToPolygon method for type ST_Geometry

Converts the geometry to a polygon.

Syntax

geometry-expression.**ST_ToPolygon**()

Returns

- **ST_Polygon** If the *geometry-expression* is of type ST_Polygon, returns the *geometry-expression*. If the *geometry-expression* is of type ST_CurvePolygon, returns *geometry-expression*.ST_CurvePolyToPoly(). If the *geometry-expression* is a geometry collection with a single element of type ST_CurvePolygon, returns that element. If the *geometry-expression* is the empty set, returns an empty set of type ST_Polygon. Otherwise, raises an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Convert the geometry to a polygon. The logic is equivalent to that used for **CAST(** *geometry-expression* **AS ST_Polygon)**. If the *geometry-expression* is a curve polygon, it is approximated using ST_CurvePolyToPoly().

If *geometry-expression* is already known to be an ST_Polygon value, it is more efficient to use TREAT(*geometry-expression* AS ST_Polygon) than the ST_ToPolygon method.

> **Note**
> By default, ST_ToPolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_ToCurvePoly method for type ST_Geometry” on page 195
- “ST_ToSurface method for type ST_Geometry” on page 206
- “ST_ToMultiPolygon method for type ST_Geometry” on page 201
- “ST_CurvePolyToPoly method for type ST_CurvePolygon” on page 79

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.33

Example

The following example returns the result `Polygon EMPTY`.

```
SELECT NEW ST_GeomCollection().ST_ToPolygon().ST_AsText()
```

The following returns an error because the Shape column is of type ST_Geometry and ST_Geometry does not support the ST_Area method.

```
SELECT Shape.ST_Area()
FROM SpatialShapes WHERE ShapeID = 22
```

The following uses ST_ToPolygon to change the type of the Shape column expression to ST_Polygon. ST_Area returns the result `12.5`.

```
SELECT Shape.ST_ToPolygon().ST_Area()
FROM SpatialShapes WHERE ShapeID = 22
```


In this case, the value of the Shape column is known be of type ST_Polygon, so TREAT can be used to efficiently change the type of the expression. ST_Area returns the result `12.5`.

```
SELECT TREAT( Shape AS ST_Polygon ).ST_Area()
FROM SpatialShapes WHERE ShapeID = 22
```

ST_ToSurface method for type ST_Geometry

Converts the geometry to a surface.

Syntax

geometry-expression.**ST_ToSurface**()

Returns

- **ST_Surface** If the *geometry-expression* is of type ST_Surface, return the *geometry-expression*. If the *geometry-expression* is a geometry collection with a single element of type ST_Surface, return that element. If the *geometry-expression* is the empty set, return an empty set of type ST_Polygon. Otherwise, raise an exception condition.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

Converts the geometry to a surface. The logic is equivalent to that used for **CAST(** *geometry-expression* **AS ST_Surface)**.

If *geometry-expression* is already known to be an ST_Surface value, it is more efficient to use TREAT(*geometry-expression* AS ST_Surface) than the ST_ToSurface method.

Note
By default, ST_ToSurface uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_ToCurvePoly method for type ST_Geometry" on page 195
- "ST_ToPolygon method for type ST_Geometry" on page 204
- "ST_ToMultiSurface method for type ST_Geometry" on page 202

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon EMPTY`.

```
SELECT NEW ST_GeomCollection().ST_ToSurface()
```

ST_Touches method for type ST_Geometry

Tests if a geometry value spatially touches another geometry value.

Syntax

geometry-expression.**ST_Touches**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* touches *geo2*, otherwise 0. Returns NULL if both *geometry-expression* and *geo2* have dimension 0.

Remarks

Tests if a geometry value spatially touches another geometry value. Two geometries spatially touch if their interiors do not intersect but one or more boundary points from one value intersects the interior or boundary of the other value.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

Note
This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_Boundary method for type ST_Geometry" on page 134
- "ST_Dimension method for type ST_Geometry" on page 149

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.28

Example

The following example returns NULL because both inputs are points and have no boundary.

```
SELECT NEW ST_Point(1,1).ST_Touches( NEW ST_Point( 1,1 ) )
```

The following example lists the ShapeIDs of the geometries that touch the "Lighting Bolt" shape, which has ShapeID 6. This example returns the result `5,16,26`. Each of the three touching geometries intersect the Lighting Bolt only at its boundary.

```
SELECT List( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE Shape.ST_Touches( ( SELECT Shape FROM SpatialShapes WHERE ShapeID =
6 ) ) = 1
```

ST_Transform method for type ST_Geometry

Creates a copy of the geometry value transformed into the specified spatial reference system.

Syntax

geometry-expression.**ST_Transform**(*srid*)

Parameters

Name	Type	Description
srid	INT	The SRID of the result.

Returns

- **ST_Geometry** Returns a copy of the geometry value transformed into the specified spatial reference system.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Remarks

The ST_Transform method transforms *geometry-expression* from its spatial reference system to the specified spatial reference system using the transform definition of both spatial reference systems. The transformation is performed using the PROJ.4 library.

ST_Transform is required to move between different coordinate systems. For example, use can use ST_Transform to transform a geometry which uses latitude and longitude to a geometry with the SRID 3310 "NAD83 / California Albers". The "NAD83 / California Albers" spatial reference system is a planar projection for California data which uses the Albers projection algorithm and metres for its linear unit of measure.

Transformations from a lat/long system to a Cartesian system can be problematic for polar points. If the database server is unable to transform a point close to the North or South pole, the latitude value of the point is shifted a small distance (slightly more than 1e-10 radians) away from the pole, and along the same longitude, so that the transformation can succeed.

If you are transforming a geometry between two spatial reference systems that have the same coordinate system, you can use the ST_SRID method instead of ST_Transform.

The spatial tutorial includes steps showing you how to transforming data between spatial reference systems. See "Tutorial: Experimenting with the spatial features" on page 47.

See also

- "ST_SRID method for type ST_Geometry" on page 185

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.6

Example

The following example returns the result `Point (184755.86861 -444218.175691)`. It transforms a point in Los Angeles which is specified in longitude and latitude to the projected planar SRID 3310 ("NAD83 / California Albers"). This example assumes that the 'st_geometry_predefined_srs' feature has been installed by the "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

```
SELECT NEW ST_Point( -118, 34, 4326 ).ST_Transform( 3310 )
```

ST_Union method for type ST_Geometry

Returns the geometry value that represents the point set union of two geometries.

Syntax

geometry-expression.**ST_Union**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be unioned with the *geometry-expression*.

Returns

- **ST_Geometry** Returns the geometry value that represents the point set union of two geometries.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *geometry-expression*.

Remarks

The ST_Union method finds the spatial union of two geometries. A point is included in the union if it is present in either of the two input geometries.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

See also

- “ST_Difference method for type ST_Geometry” on page 147
- “ST_Intersection method for type ST_Geometry” on page 163
- “ST_SymDifference method for type ST_Geometry” on page 190
- “ST_UnionAggr method for type ST_Geometry” on page 210

Standards and compatibility

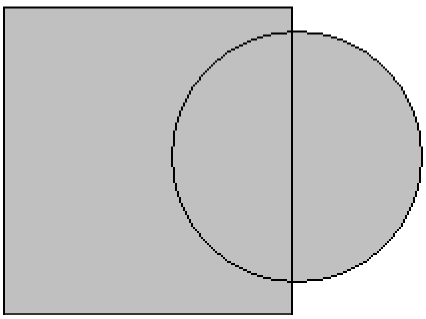
- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.19

Example

The following example shows the union (C) of a square (A) and a circle (B).

```
SELECT NEW ST_Polygon( 'Polygon( (-1 -0.25, 1 -0.25, 1 2.25, -1 2.25, -1 
-0.25) )' ) AS A
    , NEW ST_CurvePolygon( 'CurvePolygon( CircularString( 0 1, 1 2, 2 1, 1 0, 
0 1 ) )' )  AS B
    , A.ST_Union( B ) AS C
```

The union is shaded in the following picture. The union is a single surface that includes all of the points that are in A or in B.



ST_UnionAggr method for type ST_Geometry

Returns the spatial union of all of the geometries in a group

Syntax

ST_Geometry::**ST_UnionAggr**(*geometry-column*)

Parameters

Name	Type	Description
geometry-column	ST_Geometry	The geometry values to generate the spatial union. Typically this is a column.

Returns

- **ST_Geometry** Returns a geometry that is the spatial union for all the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

If the group contains a single non-NULL geometry, it is returned. Otherwise, the union is logically computed by repeatedly applying the ST_Union method to combine two geometries at a time. See "ST_Union method for type ST_Geometry" on page 209.

See also

- "ST_Union method for type ST_Geometry" on page 209

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon ((.555555 3, 0 3, 0 1.75, 0 0, 3 0, 3 3, .75 3, 1 4, .555555 3))`.

```
SELECT ST_Geometry::ST_UnionAggr( Shape )
FROM SpatialShapes WHERE ShapeID IN ( 2, 6 )
```

ST_Within method for type ST_Geometry

Tests if a geometry value is spatially contained within another geometry value.

Syntax

geometry-expression.**ST_Within**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* is within *geo2*, otherwise 0.

Remarks

The ST_Within method tests if the *geometry-expression* is completely within *geo2* and there is one or more interior points of *geo2* that lies in the interior of the *geometry-expression*.

geometry-expression.ST_Within(*geo2*) is equivalent to *geo2*.ST_Contains(*geometry-expression*).

The ST_Within and ST_CoveredBy methods are similar. The difference is that ST_CoveredBy does not require intersecting interior points.

> **Note**
> If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Contains method for type ST_Geometry" on page 135
- "ST_CoveredBy method for type ST_Geometry" on page 142
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_WithinFilter method for type ST_Geometry" on page 216

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.30

Example

The following example tests if a point is within a polygon. The point is completely within the polygon, and the interior of the point (the point itself) intersects the interior of the polygon, so the example returns 1.

```
SELECT NEW ST_Point( 1, 1 )
    .ST_Within( NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' ) )
```

The following example tests if a line is within a polygon. The line is completely within the polygon, but the interior of the line and the interior of the polygon do not intersect (the line only intersects the polygon on the polygon's boundary, and the boundary is not part of the interior), so the example returns 0. If ST_CoveredBy was used in place of ST_Within, ST_CoveredBy would return 1.

```
SELECT NEW ST_LineString( 'LineString( 0 0, 1 0 )' )
    .ST_Within( NEW ST_Polygon( 'Polygon(( 0 0, 2 0, 1 2, 0 0 ))' ) )
```

The following example lists the ShapeIDs where the given point is within the Shape geometry. This example returns the result `3,5`. Note that ShapeID 6 is not listed because the point intersects that row's Shape polygon at the polygon's boundary.

```
SELECT LIST( ShapeID ORDER BY ShapeID )
FROM SpatialShapes
WHERE NEW ST_Point( 1, 4 ).ST_Within( Shape ) = 1
```

ST_WithinDistance method for type ST_Geometry

Test if two geometries are within a specified distance of each other.

Syntax

geometry-expression.**ST_WithinDistance**(*geo2*,*distance*[, *unit-name*])

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value whose distance is to be measured from the *geometry-expression*.
distance	DOUBLE	The distance the two geometries should be within.
unit-name	VARCHAR(128)	The units in which the distance parameter should be interpreted. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **BIT** Returns 1 if *geometry-expression* and *geo2* are within the specified distance of each other, otherwise 0.

Remarks

The ST_WithinDistance method tests if the smallest distance between two geometries does not exceed a specified distance, taking tolerance into consideration.

More precisely, let *d* denote the smallest distance between *geometry-expression* and *geo2*. The expression `geometry-expression.ST_WithinDistance( geo2, distance[, unit_name])` evaluates to 1 if either *d* <= *distance* or if *d* exceeds *distance* by a length that is less than the tolerance of the associated spatial reference system.

For planar spatial reference systems, the distance is calculated as the Cartesian distance within the plane, computed in the linear units of measure for the associated spatial reference system. For round-Earth spatial reference systems, the distance is computed taking the curvature of the Earth's surface into account using the ellipsoid parameters in the spatial reference system definition.

Note
If the *geometry-expression* contains circular strings, then these are interpolated to line strings.

Note
For round-Earth spatial reference systems, the ST_WithinDistance method is only supported if *geometry-expression* and *geo2* contain only points.

See also

- "ST_Distance method for type ST_Geometry" on page 151
- "ST_WithinDistanceFilter method for type ST_Geometry" on page 214
- "ST_Intersects method for type ST_Geometry" on page 165

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns an ordered result set with one row for each shape that is within distance 1.4 of the point (2,3).

```
SELECT ShapeID, ROUND( Shape.ST_Distance( NEW ST_Point( 2, 3 ) ), 2 ) AS dist
FROM SpatialShapes
WHERE ShapeID < 17
AND Shape.ST_WithinDistance( NEW ST_Point( 2, 3 ), 1.4 ) = 1
ORDER BY dist
```

The example returns the following result set:

ShapeID	dist
2	0.0
3	0.0
5	1.0
6	1.21

The following example creates points representing Halifax, NS and Waterloo, ON, Canada and uses ST_WithinDistance to demonstrate that the distance between the two points is within 850 miles, but not within 840 miles. This example assumes that the 'st_geometry_predefined_uom' feature has been installed by the "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

```
SELECT NEW ST_Point( -63.573566, 44.646244, 4326 )
    .ST_WithinDistance( NEW ST_Point( -80.522372, 43.465187, 4326 )
                        , 850, 'Statute mile' ) within850,
    NEW ST_Point( -63.573566, 44.646244, 4326 )
    .ST_WithinDistance( NEW ST_Point( -80.522372, 43.465187, 4326 )
                        , 840, 'Statute mile' ) within840
```

The example returns the following result set:

within850	within840
1	0

ST_WithinDistanceFilter method for type ST_Geometry

A cheap test if two geometries might possibly be within a specified distance of each other.

Syntax

geometry-expression.**ST_WithinDistanceFilter**(*geo2*,*distance*[, *unit-name*])

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value whose distance is to be measured from the *geometry-expression*.
distance	DOUBLE	The distance the two geometries should be within.
unit-name	VARCHAR(128)	The units in which the distance parameter should be interpreted. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **BIT** Returns 1 if *geometry-expression* and *geo2* might be within the specified distance of each other, otherwise 0.

Remarks

The ST_WithinDistanceFilter method provides an efficient test to determine if two geometries might possibly be within a specified distance of each other (as determined by method ST_WithinDistance). Returns 1 if the *geometry-expression* might be within the given distance of *geo2*, otherwise 0.

This test is cheaper than ST_WithinDistance, but may return 1 in some cases where the smallest distance between the two geometries is actually larger than the specified distance. Therefore, this method can be useful as a primary filter when further processing will determine the true distance between the geometries.

The implementation of ST_WithinDistanceFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_WithinDistanceFilter is used within a query, the expression *geometry-expression*.ST_WithinDistanceFilter(*geo2*, *distance* [, *unit_name*]) can return different results when *geometry-expression* is not within the specified distance of *geo2*. Whenever *geometry-expression* is within the specified distance of *geo2*, ST_WithinDistanceFilter will always return 1.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Distance method for type ST_Geometry" on page 151
- "ST_WithinDistance method for type ST_Geometry" on page 212
- "ST_IntersectsFilter method for type ST_Geometry" on page 166

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns an ordered result set with one row for each shape that might possibly be within distance 1.4 of the point (2,3). Observe that the result contains a shape that is not actually within the specified distance.

```
SELECT ShapeID, ROUND( Shape.ST_Distance( NEW ST_Point( 2, 3 ) ), 2 ) AS dist
FROM SpatialShapes
WHERE ShapeID < 17
AND Shape.ST_WithinDistanceFilter( NEW ST_Point( 2, 3 ), 1.4 ) = 1
ORDER BY dist
```

The example returns the following result set:

ShapeID	dist
2	0.0
3	0.0
5	1.0
6	1.21
16	1.41

ST_WithinFilter method for type ST_Geometry

A cheap test if a geometry might possibly be within another.

Syntax

geometry-expression.**ST_WithinFilter**(*geo2*)

Parameters

Name	Type	Description
geo2	ST_Geometry	The other geometry value that is to be compared to the *geometry-expression*.

Returns

- **BIT** Returns 1 if the *geometry-expression* might be within *geo2*, otherwise 0.

Remarks

The ST_WithinFilter method provides an efficient test to determine if one geometry might be within the other. Returns 1 if the *geometry-expression* might be within *geo2*, otherwise 0.

This test is cheaper than ST_Within, but may return 1 in some cases where the *geometry-expression* is not actually spatially within *geo2*.

Therefore, this method can be useful as a primary filter when further processing will determine if geometries interact in the desired way.

The implementation of ST_WithinFilter relies upon meta-data associated with the stored geometries. Because the available meta-data may change between server versions, depending upon how the data is loaded, or where ST_WithinFilter is used within a query, the expression *geometry-expression*.ST_WithinFilter(*geo2*) can return different results when *geometry-expression* is not within *geo2*. Whenever *geometry-expression* is within *geo2*, ST_WithinFilter will always return 1.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Within method for type ST_Geometry" on page 211

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_XMax method for type ST_Geometry

Retrieves the maximum X coordinate value of a geometry.

Syntax

geometry-expression.**ST_XMax**()

Returns

- **DOUBLE** Returns the maximum X coordinate value of the *geometry-expression*.

Remarks

Returns the maximum X coordinate value of the *geometry-expression*. This is computed by comparing the X attribute of all points in the geometry.

Note that in round-Earth model, minimum corresponds to eastern boundary of the *geometry-expression* and maximum corresponds to the western boundary of the *geometry-expression*. This means that if the *geometry-expression* crosses date line, minimum value will be higher than maximum value.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_XMax uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMin method for type ST_Geometry" on page 218
- "ST_YMin method for type ST_Geometry" on page 220
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMin method for type ST_Geometry" on page 222
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMin method for type ST_Geometry" on page 177
- "ST_MMax method for type ST_Geometry" on page 177
- "ST_LongEast method for type ST_Geometry" on page 175

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 5.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_XMax()
```

ST_XMin method for type ST_Geometry

Retrieves the minimum X coordinate value of a geometry.

Syntax

geometry-expression.**ST_XMin**()

Returns

- **DOUBLE** Returns the minimum X coordinate value of the *geometry-expression*.

Remarks

Returns the minimum X coordinate value of the *geometry-expression*. This is computed by comparing the X attribute of all points in the geometry.

Note that in round-Earth model, minimum corresponds to eastern boundary of the *geometry-expression* and maximum corresponds to the western boundary of the *geometry-expression*. This means that if the *geometry-expression* crosses date line, minimum value will be higher than maximum value.

Note
If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_XMin uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMax method for type ST_Geometry" on page 217
- "ST_YMin method for type ST_Geometry" on page 220
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMin method for type ST_Geometry" on page 222
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMin method for type ST_Geometry" on page 177
- "ST_MMax method for type ST_Geometry" on page 177
- "ST_LongWest method for type ST_Geometry" on page 176

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 1.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_XMin()
```

ST_YMax method for type ST_Geometry

Retrieves the maximum Y coordinate value of a geometry.

Syntax

geometry-expression.**ST_YMax**()

Returns

- **DOUBLE** Returns the maximum Y coordinate value of the *geometry-expression*.

Remarks

Returns the maximum Y coordinate value of the *geometry-expression*. This is computed by comparing the Y attribute of all points in the geometry.

Note that in round-Earth model, minimum corresponds to southernmost point of the *geometry-expression* (which may not be one of the points defining the geometry) and maximum corresponds to the northernmost point of the *geometry-expression*.

Note
If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_YMax uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_XMin method for type ST_Geometry” on page 218
- “ST_XMax method for type ST_Geometry” on page 217
- “ST_YMin method for type ST_Geometry” on page 220
- “ST_ZMin method for type ST_Geometry” on page 222
- “ST_ZMax method for type ST_Geometry” on page 221
- “ST_MMin method for type ST_Geometry” on page 177
- “ST_MMax method for type ST_Geometry” on page 177
- “ST_LatNorth method for type ST_Geometry” on page 171

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 6.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_YMax()
```

ST_YMin method for type ST_Geometry

Retrieves the minimum Y coordinate value of a geometry.

Syntax

geometry-expression.**ST_YMin**()

Returns

- **DOUBLE** Returns the minimum Y coordinate value of the *geometry-expression*.

Remarks

Returns the minimum Y coordinate value of the *geometry-expression*. This is computed by comparing the Y attribute of all points in the geometry.

Note that in round-Earth model, minimum corresponds to southernmost point of the *geometry-expression* (which may not be one of the points defining the geometry) and maximum corresponds to the northernmost point of the *geometry-expression*.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_YMin uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMin method for type ST_Geometry" on page 218
- "ST_XMax method for type ST_Geometry" on page 217
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMin method for type ST_Geometry" on page 222
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMin method for type ST_Geometry" on page 177
- "ST_MMax method for type ST_Geometry" on page 177
- "ST_LatSouth method for type ST_Geometry" on page 172

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 2.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_YMin()
```

ST_ZMax method for type ST_Geometry

Retrieves the maximum Z coordinate value of a geometry.

Syntax

geometry-expression.**ST_ZMax**()

Returns

- **DOUBLE** Returns the maximum Z coordinate value of the *geometry-expression*.

Remarks

Returns the maximum Z coordinate value of the *geometry-expression*. This is computed by comparing the Z attribute of all points in the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_ZMax uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- “ST_XMin method for type ST_Geometry” on page 218
- “ST_XMax method for type ST_Geometry” on page 217
- “ST_YMin method for type ST_Geometry” on page 220
- “ST_YMax method for type ST_Geometry” on page 219
- “ST_ZMin method for type ST_Geometry” on page 222
- “ST_MMin method for type ST_Geometry” on page 177
- “ST_MMax method for type ST_Geometry” on page 177

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 7.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_ZMax()
```

ST_ZMin method for type ST_Geometry

Retrieves the minimum Z coordinate value of a geometry.

Syntax

geometry-expression.**ST_ZMin**()

Returns

- **DOUBLE** Returns the minimum Z coordinate value of the *geometry-expression*.

Remarks

Returns the minimum Z coordinate value of the *geometry-expression*. This is computed by comparing the Z attribute of all points in the geometry.

> **Note**
> If the *geometry-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_ZMin uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_XMin method for type ST_Geometry" on page 218
- "ST_XMax method for type ST_Geometry" on page 217
- "ST_YMin method for type ST_Geometry" on page 220
- "ST_YMax method for type ST_Geometry" on page 219
- "ST_ZMax method for type ST_Geometry" on page 221
- "ST_MMin method for type ST_Geometry" on page 177
- "ST_MMax method for type ST_Geometry" on page 177

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result 3.

```
SELECT NEW ST_LineString( 'LineString ZM( 1 2 3 4, 5 6 7 8 )' ).ST_ZMin()
```

ST_LineString type

The ST_LineString type is a subtype of ST_Curve that uses straight line segments between control points.

Direct supertype

- "ST_Curve type" on page 69

Constructor

- "ST_LineString constructor" on page 224

Methods

- "ST_LineStringAggr method for type ST_LineString" on page 227
- "ST_NumPoints method for type ST_LineString" on page 227
- "ST_PointN method for type ST_LineString" on page 228
- All methods of "ST_Curve type" on page 69 can also be called on a ST_LineString type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_LineString type.

Remarks

The ST_LineString type is a subtype of ST_Curve that uses straight line segments between control points. Each consecutive pair of points is joined with a straight line segment.

A line is an ST_LineString value with exactly two points. A linear ring is an ST_LineString value which is closed and simple.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2

ST_LineString constructor

Constructs a linestring

Overload list

Name	Description
"ST_LineString() constructor" on page 224	Constructs a linestring representing the empty set.
"ST_LineString(LONG VARCHAR[, INT]) constructor" on page 224	Constructs a linestring from a text representation.
"ST_LineString(LONG BINARY[, INT]) constructor" on page 225	Constructs a linestring from WKB.
"ST_LineString(ST_Point,ST_Point,...) constructor" on page 226	Constructs a linestring value from a list of points in a specified spatial reference system.

ST_LineString() constructor

Constructs a linestring representing the empty set.

Syntax

NEW ST_LineString()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_LineString().ST_IsEmpty()
```

ST_LineString(LONG VARCHAR[, INT]) constructor

Constructs a linestring from a text representation.

Syntax

NEW ST_LineString(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a linestring. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a linestring from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.2

Example

The following returns LineString (0 0, 5 10)

```
SELECT NEW ST_LineString('LineString (0 0, 5 10)')
```

ST_LineString(LONG BINARY[, INT]) constructor

Constructs a linestring from WKB.

Syntax

NEW ST_LineString(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an linestring. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a linestring from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.2

Example

The following returns LineString (0 0, 5 10)

```
SELECT NEW
ST_LineString(0x0102000000020000000000000000000000000000000000000000000000000
01440000000000000002440)
```

ST_LineString(ST_Point,ST_Point,...) constructor

Constructs a linestring value from a list of points in a specified spatial reference system.

Syntax

NEW ST_LineString(*pt1*,*pt2*,[*pt3*,...,*ptN*])

Parameters

Name	Type	Description
pt1	ST_Point	The first point of the linestring.
pt2	ST_Point	The second point of the linestring.
pt3,...,ptN	ST_Point	Additional points of the linestring.

Remarks

Constructs a linestring value from a list of points. All of the points must have the same SRID. The resulting linestring is constructed with this common SRID. All of the supplied points must be non-empty and have the same answer for Is3D and IsMeasured. The linestring is 3D if all of the points are 3D, and the linestring is measured if all of the points are measured.

Note
By default, ST_LineString uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `LineString (0 0, 1 1)`.

```
SELECT NEW ST_LineString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ) )
```

The following example returns the result `LineString (0 0, 1 1, 2 0)`.

```
SELECT NEW ST_LineString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1, 1 ), NEW
ST_Point(2,0) )
```


ST_LineStringAggr method for type ST_LineString

Returns a linestring built from the ordered points in a group.

Syntax

ST_LineString::**ST_LineStringAggr**(*point*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
point	ST_Point	The points to generate the linestring. Typically this is a column.

Returns

- **ST_LineString** Returns a linestring built from the points in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_LineStringAggr aggregate function can be used to build a linestring out of a group of ordered points. All of the geometry columns to be combined must have the same SRID. All of the points to be combined must be non-empty with the same coordinate dimension.

Rows where the *linestring-expression* is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting linestring has the same coordinate dimension as each point.

> **Note**
> The ORDER BY clause should be specified to control the order of points within the linestring. If not present, the order of points in the linestring will vary depending on the access plan selected by the query optimizer.

> **Note**
> By default, ST_LineStringAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_NumPoints method for type ST_LineString

Returns the number of points defining the linestring.

> **Note**
> By default, ST_NumPoints uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

linestring-expression.**ST_NumPoints**()

Returns

- **INT** Returns NULL if the linestring value is empty, otherwise the number of points in the value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.4

Example

The following example returns the result `NULL`.

```
SELECT NEW ST_LineString().ST_NumPoints()
```

The following example returns the result `2`.

```
SELECT NEW ST_LineString( NEW ST_Point( 0, 0 ), NEW ST_Point( 1,
1 ) ).ST_NumPoints()
```

ST_PointN method for type ST_LineString

Returns the *n*th point in the linestring.

> **Note**
> By default, ST_PointN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

linestring-expression.**ST_PointN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *linestring-expression*.ST_NumPoints().

Returns

- **ST_Point** If the linestring value is the empty set, returns NULL. If the specified position *n* is less than 1 or greater than the number of points, raises a warning and returns NULL. Otherwise, returns the ST_Point value at position n.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *linestring-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.5

ST_MultiCurve type

An ST_MultiCurve is a collection of zero or more ST_Curve values, and all of the curves are within the spatial reference system. The length of a multicurve is the sum of the lengths of the contained curves. A multicurve is closed if it is non-empty and has an empty boundary.

Direct supertype

- "ST_GeomCollection type" on page 82

Direct subtypes

- "ST_MultiLineString type" on page 235

Constructor

- "ST_MultiCurve constructor" on page 229

Methods

- "ST_IsClosed method for type ST_MultiCurve" on page 232
- "ST_Length method for type ST_MultiCurve" on page 233
- "ST_MultiCurveAggr method for type ST_MultiCurve" on page 234
- All methods of "ST_GeomCollection type" on page 82 can also be called on a ST_MultiCurve type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_MultiCurve type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3

ST_MultiCurve constructor

Constructs a multi curve

Overload list

Name	Description
"ST_MultiCurve() constructor" on page 230	Constructs a multi curve representing the empty set.
"ST_MultiCurve(LONG VARCHAR[, INT]) constructor" on page 230	Constructs a multi curve from a text representation.
"ST_MultiCurve(LONG BINARY[, INT]) constructor" on page 231	Constructs a multi curve from WKB.
"ST_MultiCurve(ST_Curve,...) constructor" on page 231	Constructs a multi-curve from a list of curve values.

ST_MultiCurve() constructor

Constructs a multi curve representing the empty set.

Syntax

NEW ST_MultiCurve()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_MultiCurve().ST_IsEmpty()
```

ST_MultiCurve(LONG VARCHAR[, INT]) constructor

Constructs a multi curve from a text representation.

Syntax

NEW ST_MultiCurve(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a multi curve. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi curve from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.2

Example

The following returns MultiCurve ((10 10, 12 12), CircularString (5 10, 10 12, 15 10))

```
SELECT NEW ST_MultiCurve('MultiCurve ((10 10, 12 12), CircularString (5 10,
10 12, 15 10))')
```

ST_MultiCurve(LONG BINARY[, INT]) constructor

Constructs a multi curve from WKB.

Syntax

NEW ST_MultiCurve(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an multi curve. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi curve from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.2

Example

The following returns MultiCurve (CircularString (5 10, 10 12, 15 10))

```
SELECT NEW
ST_MultiCurve(0x010b000000010000000108000000030000000000000000001440000000000
00024400000000000000244000000000000002840000000000000002e400000000000002440)
```

ST_MultiCurve(ST_Curve,...) constructor

Constructs a multi-curve from a list of curve values.

Syntax

NEW ST_MultiCurve(*curve1*,[*curve2*,...,*curveN*])

Parameters

Name	Type	Description
curve1	ST_Curve	The first curve value of the multi-curve.
curve2,...,curveN	ST_Curve	Additional curve values of the multi-curve.

Remarks

Constructs a multi-curve from a list of curve values. All of the supplied curve values must have the same SRID, and the multi-curve is constructed with this common SRID.

All of the supplied curve values must have the same answer for Is3D and IsMeasured. The multi-curve is 3D if all of the curve values are 3D, and the multi-curve is measured if all of the curve values are measured.

> **Note**
> By default, ST_MultiCurve uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `MultiCurve ((0 0, 1 1))`.

```
SELECT NEW ST_MultiCurve( NEW ST_LineString('LineString (0 0, 1 1)' ) )
```

The following example returns the result `MultiCurve ((0 0, 1 1), CircularString (0 0, 1 1, 2 0))`.

```
SELECT NEW ST_MultiCurve(
    NEW ST_LineString('LineString (0 0, 1 1)' ),
    NEW ST_CircularString( 'CircularString( 0 0, 1 1, 2 0)' ) )
```

ST_IsClosed method for type ST_MultiCurve

Tests if the ST_MultiCurve value is closed. A curve is closed if the start and end points are coincident.

Note
By default, ST_IsClosed uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

multicurve-expression.**ST_IsClosed**()

Returns

- **BIT** Returns 1 if the multicurve is closed, otherwise 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.3

ST_Length method for type ST_MultiCurve

Returns the length measurement of the ST_MultiCurve value. The result is measured in the units specified by the parameter.

Syntax

multicurve-expression.**ST_Length**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VARCHAR(128)	The units in which the length should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the length measurement of the ST_MultiCurve value.

Remarks

The ST_Length method returns the length of a multicurve in the units identified by the *unit-name* parameter. If the curve is empty, then NULL is returned.

If the curve contains Z values, these are not considered when computing the length of the geometry.

Note
If the *multicurve-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Length uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

See also

- "ST_Length method for type ST_Curve" on page 72

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.4

Example

The following example creates a multicurve and uses ST_Length to find the length of the geometry, returning the value PI+1.

```
SELECT NEW ST_MultiCurve(
        NEW ST_LineString('LineString (0 0, 1 0)' ),
        NEW ST_CircularString( 'CircularString( 0 0, 1 1, 2 0)' ) )
    .ST_Length()
```

The following example creates a multicurve and an example unit of measure (example_unit_halfmetre). The ST_Length method finds the length of the geometry in this unit of measure, returning the value 6.0.

```
begin
    declare @multi_curve ST_MultiCurve;
    CREATE SPATIAL UNIT OF MEASURE IF NOT EXISTS  "example_unit_halfmetre"
TYPE LINEAR CONVERT USING .5;
    set @multi_curve = NEW ST_MultiCurve(
        NEW ST_LineString('LineString (0 0, 1 0)' ),
        NEW ST_LineString('LineString (0 2, 2 2)' ) );
    SELECT @multi_curve.ST_Length('example_unit_halfmetre');
end
```

ST_MultiCurveAggr method for type ST_MultiCurve

Returns a multicurve containing all of the curves in a group

Syntax

ST_MultiCurve::**ST_MultiCurveAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
geometry-column	ST_Curve	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_MultiCurve** Returns a multicurve that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_MultiCurveAggr aggregate function can be used to combine a group of curves into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_MultiCurve has the same coordinate dimension as each curves.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

> **Note**
> By default, ST_MultiCurveAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_MultiLineString type

An ST_MultiLineString is a collection of zero or more ST_LineString values, and all of the linestrings are within the spatial reference system.

Direct supertype

- "ST_MultiCurve type" on page 229

Constructor

- "ST_MultiLineString constructor" on page 236

Methods

- “ST_MultiLineStringAggr method for type ST_MultiLineString” on page 239
- All methods of “ST_MultiCurve type” on page 229 can also be called on a ST_MultiLineString type.
- All methods of “ST_GeomCollection type” on page 82 can also be called on a ST_MultiLineString type.
- All methods of “ST_Geometry type” on page 88 can also be called on a ST_MultiLineString type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.4

ST_MultiLineString constructor

Constructs a multi linestring

Overload list

Name	Description
“ST_MultiLineString() constructor” on page 236	Constructs a multi linestring representing the empty set.
“ST_MultiLineString(LONG VARCHAR[, INT]) constructor” on page 237	Constructs a multi linestring from a text representation.
“ST_MultiLineString(LONG BINARY[, INT]) constructor” on page 237	Constructs a multi linestring from WKB.
“ST_MultiLineString(ST_LineString,...) constructor” on page 238	Constructs a multi-linestring from a list of linestring values.

ST_MultiLineString() constructor

Constructs a multi linestring representing the empty set.

Syntax

NEW ST_MultiLineString()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_MultiLineString().ST_IsEmpty()
```


ST_MultiLineString(LONG VARCHAR[, INT]) constructor

Constructs a multi linestring from a text representation.

Syntax

NEW ST_MultiLineString(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a multi linestring. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi linestring from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.4.2

Example

The following returns MultiLineString ((10 10, 12 12), (14 10, 16 12))

```
SELECT NEW ST_MultiLineString('MultiLineString ((10 10, 12 12), (14 10, 16
12))')
```

ST_MultiLineString(LONG BINARY[, INT]) constructor

Constructs a multi linestring from WKB.

Syntax

NEW ST_MultiLineString(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an multi linestring. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi linestring from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.4.2

Example

The following returns MultiLineString ((10 10, 12 12))

```
SELECT NEW
ST_MultiLineString(0x0105000000010000000102000000020000000000000000002440000000
00000000244000000000000028400000000000002840)
```

ST_MultiLineString(ST_LineString,...) constructor

Constructs a multi-linestring from a list of linestring values.

Syntax

NEW ST_MultiLineString(*linestring1*,[*linestring2*,...,*linestringN*])

Parameters

Name	Type	Description
linestring1	ST_LineString	The first linestring value of the multi-linestring.
linestring2,...,linestringN	ST_LineString	Additional linestring values of the multi-linestring.

Remarks

Constructs a multi-linestring from a list of linestring values. All of the supplied linestring values must have the same SRID, and the multi-linestring is constructed with this common SRID.

All of the supplied linestring values must have the same answer for Is3D and IsMeasured. The multi-linestring is 3D if all of the linestring values are 3D, and the multi-linestring is measured if all of the linestring values are measured.

> **Note**
> By default, ST_MultiLineString uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a multilinestring containing a single linestring and is equivalent to the following WKT: `'MultiLineString ((0 0, 1 1))'`

```
SELECT NEW ST_MultiLineString( NEW ST_LineString('LineString (0 0, 1 1)' ) )
```

The following returns a multilinestring containing two linestrings equivalent to the following WKT: `'MultiLineString ((0 0, 1 1), (0 0, 1 1, 2 0))'`.

```
SELECT NEW ST_MultiLineString(
        NEW ST_LineString('LineString (0 0, 1 1)' ),
        NEW ST_LineString( 'LineString( 0 0, 1 1, 2 0)' ) )
```

ST_MultiLineStringAggr method for type ST_MultiLineString

Returns a multilinestring containing all of the linestrings in a group

Syntax

ST_MultiLineString::**ST_MultiLineStringAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
geometry-column	ST_LineString	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_MultiLineString** Returns a multilinestring that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_MultiLineStringAggr aggregate function can be used to combine a group of linestrings into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_MultiLineString has the same coordinate dimension as each linestrings.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

> **Note**
> By default, ST_MultiLineStringAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_MultiPoint type

An ST_MultiPoint is a collection of zero or more ST_Point values, and all of the points are within the spatial reference system.

Direct supertype

- "ST_GeomCollection type" on page 82

Constructor

- "ST_MultiPoint constructor" on page 240

Methods

- "ST_MultiPointAggr method for type ST_MultiPoint" on page 243
- All methods of "ST_GeomCollection type" on page 82 can also be called on a ST_MultiPoint type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_MultiPoint type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.2

ST_MultiPoint constructor

Constructs a multi point

Overload list

Name	Description
"ST_MultiPoint() constructor" on page 241	Constructs a multi point representing the empty set.

Name	Description
"ST_MultiPoint(LONG VARCHAR[, INT]) constructor" on page 241	Constructs a multi point from a text representation.
"ST_MultiPoint(LONG BINARY[, INT]) constructor" on page 242	Constructs a multi point from WKB.
"ST_MultiPoint(ST_Point,...) constructor" on page 242	Constructs a multi-point from a list of point values.

ST_MultiPoint() constructor

Constructs a multi point representing the empty set.

Syntax

NEW ST_MultiPoint()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_MultiPoint().ST_IsEmpty()
```

ST_MultiPoint(LONG VARCHAR[, INT]) constructor

Constructs a multi point from a text representation.

Syntax

NEW ST_MultiPoint(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a multi point. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi point from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.2.2

Example

The following returns MultiPoint ((10 10), (12 12), (14 10))

```
SELECT NEW ST_MultiPoint('MultiPoint ((10 10), (12 12), (14 10))')
```

ST_MultiPoint(LONG BINARY[, INT]) constructor

Constructs a multi point from WKB.

Syntax

NEW ST_MultiPoint(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the binary representation of an multi point. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi point from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.2.2

Example

The following returns MultiPoint ((10 10), (12 12), (14 10))

```
SELECT NEW
ST_MultiPoint(0x0104000000030000000101000000000000000000244000000000000000244000
1010000000000000000002840000000000000002840010100000000000000000000002c400000000000
002440)
```

ST_MultiPoint(ST_Point,...) constructor

Constructs a multi-point from a list of point values.

Syntax

NEW ST_MultiPoint(*point1*,[*point2*,...,*pointN*])

Parameters

Name	Type	Description
point1	ST_Point	The first point value of the multi-point.
point2,...,pointN	ST_Point	Additional point values of the multi-point.

Remarks

Constructs a multi-point from a list of point values. All of the supplied point values must have the same SRID, and the multi-point is constructed with this common SRID.

All of the supplied point values must have the same answer for Is3D and IsMeasured. The multi-point is 3D if all of the point values are 3D, and the multi-point is measured if all of the point values are measured.

> **Note**
> By default, ST_MultiPoint uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a multi-point containing the single point `'Point (1 2)'`.

```
SELECT NEW ST_MultiPoint( NEW ST_Point( 1.0, 2.0 ) )
```

The following returns a multi-point containing two points `'Point (1 2)'` and `'Point (3 4)'`.

```
SELECT NEW ST_MultiPoint( NEW ST_Point( 1.0, 2.0 ), NEW ST_Point( 3.0, 4.0 ) )
```

ST_MultiPointAggr method for type ST_MultiPoint

Returns a multipoint containing all of the points in a group

Syntax

ST_MultiPoint::**ST_MultiPointAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
geometry-column	ST_Point	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_MultiPoint** Returns a multipoint that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_MultiPointAggr aggregate function can be used to combine a group of points into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_MultiPoint has the same coordinate dimension as each points.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

Note
By default, ST_MultiPointAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_MultiPolygon type

An ST_MultiPolygon is a collection of zero or more ST_Polygon value, and all of the polygons are within the spatial reference system.

Direct supertype

- "ST_MultiSurface type" on page 250

Constructor

- "ST_MultiPolygon constructor" on page 245

Methods

- "ST_MultiPolygonAggr method for type ST_MultiPolygon" on page 249
- All methods of "ST_MultiSurface type" on page 250 can also be called on a ST_MultiPolygon type.
- All methods of "ST_GeomCollection type" on page 82 can also be called on a ST_MultiPolygon type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_MultiPolygon type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6

ST_MultiPolygon constructor

Constructs a multi polygon

Overload list

Name	Description
"ST_MultiPolygon() constructor" on page 245	Constructs a multi polygon representing the empty set.
"ST_MultiPolygon(LONG VARCHAR[, INT]) constructor" on page 246	Constructs a multi polygon from a text representation.
"ST_MultiPolygon(LONG BINARY[, INT]) constructor" on page 246	Constructs a multi polygon from WKB.
"ST_MultiPolygon(ST_Polygon,...) constructor" on page 247	Constructs a multi-polygon from a list of polygon values.
"ST_MultiPolygon(ST_MultiLineString[, VARCHAR(128)]) constructor" on page 248	Creates a multi-polygon from a multilinestring containing exterior rings and an optional list of interior rings.

ST_MultiPolygon() constructor

Constructs a multi polygon representing the empty set.

Syntax

NEW ST_MultiPolygon()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_MultiPolygon().ST_IsEmpty()
```

ST_MultiPolygon(LONG VARCHAR[, INT]) constructor

Constructs a multi polygon from a text representation.

Syntax

NEW ST_MultiPolygon(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a multi polygon. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi polygon from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.2

Example

The following returns MultiPolygon (((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2, -2 2, 2 2, 2 -2, -2 -2)), ((10 -5, 15 5, 5 5, 10 -5)))

```
SELECT NEW ST_MultiPolygon('MultiPolygon (((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2,
-2 2, 2 2, 2 -2, -2 -2)), ((10 -5, 15 5, 5 5, 10 -5)))')
```

ST_MultiPolygon(LONG BINARY[, INT]) constructor

Constructs a multi polygon from WKB.

Syntax

NEW ST_MultiPolygon(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the binary representation of an multi polygon. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi polygon from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.2

Example

The following returns MultiPolygon (((10 -5, 15 5, 5 5, 10 -5)))

```
SELECT NEW
ST_MultiPolygon(0x01060000000100000001030000000100000004000000000000000000244
0000000000000014c0000000000000002e400000000000001440000000000000001440000000000000
1440000000000000244000000000000000014c0)
```

ST_MultiPolygon(ST_Polygon,...) constructor

Constructs a multi-polygon from a list of polygon values.

Syntax

NEW ST_MultiPolygon(*polygon1*,[*polygon2*,...,*polygonN*])

Parameters

Name	Type	Description
polygon1	ST_Polygon	The first polygon value of the multi-polygon.
polygon2,...,polygonN	ST_Polygon	Additional polygon values of the multi-polygon.

Remarks

Constructs a multi-polygon from a list of polygon values. All of the supplied polygon values must have the same SRID, and the multi-polygon is constructed with this common SRID.

All of the supplied polygon values must have the same answer for Is3D and IsMeasured. The multi-polygon is 3D if all of the polygon values are 3D, and the multi-polygon is measured if all of the polygon values are measured.

Note
By default, ST_MultiPolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `MultiPolygon (((0 0, 1 0, 1 1, 0 1, 0 0)))`.

```
SELECT NEW ST_MultiPolygon( NEW ST_Polygon('Polygon ((0 0, 0 1, 1 1, 1 0, 0
0))' )  )
```

The following returns a multi-surface equivalent to `'MultiPolygon (((0 0, 0 1, 1 1, 1 0, 0 0)), ((5 5, 5 10, 10 10, 10 5, 5 5)))'`

```
SELECT NEW ST_MultiPolygon(
        NEW ST_Polygon('Polygon ((0 0, 0 1, 1 1, 1 0, 0 0))' ),
        NEW ST_Polygon('Polygon ((5 5, 5 10, 10 10, 10 5, 5 5))' )  )
```

ST_MultiPolygon(ST_MultiLineString[, VARCHAR(128)]) constructor

Creates a multi-polygon from a multilinestring containing exterior rings and an optional list of interior rings.

Syntax

NEW ST_MultiPolygon(*multi-linestring*[, *polygon-format*])

Parameters

Name	Type	Description
multi-line-string	ST_MultiLine-String	A multilinestring value containing exterior rings and (optionally) a set of interior rings.
polygon-for-mat	VARCHAR(128)	A string with the polygon format to use when interpreting the provided linestrings. Valid formats are 'CounterClockwise', 'Clockwise', and 'EvenOdd'

Remarks

Creates a multi-polygon from a multilinestring containing exterior rings and an optional list of interior rings. The multilinestring must contain only linear rings.

If specified, the *polygon-format* parameter selects the algorithm the server uses to determine whether a ring is an exterior or interior ring. If not specified, the polygon format of the spatial reference system is used.

For additional information on *polygon-format*, see "POLYGON FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

> **Note**
> By default, ST_MultiPolygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns MultiPolygon (((-4 -4, 4 -4, 4 4, -4 4, -4 -4), (-2 1, -3 3, -1 3, -2 1)), ((6 -4, 14 -4, 14 4, 6 4, 6 -4), (8 1, 7 3, 9 3, 8 1))) (two square polygons each with a triangular hole).

```
SELECT NEW ST_MultiPolygon(
    NEW ST_MultiLineString ('MultiLineString ((-4 -4, 4 -4, 4 4, -4 4, -4 -4),
(-2 1, -3 3, -1 3, -2 1), (6 -4, 14 -4, 14 4, 6 4, 6 -4), (8 1, 7 3, 9 3, 8
1))'))
```

ST_MultiPolygonAggr method for type ST_MultiPolygon

Returns a multipolygon containing all of the polygons in a group

Syntax

ST_MultiPolygon::**ST_MultiPolygonAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
geometry-column	ST_Polygon	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_MultiPolygon** Returns a multipolygon that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_MultiPolygonAggr aggregate function can be used to combine a group of polygons into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_MultiPolygon has the same coordinate dimension as each polygons.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

Note
By default, ST_MultiPolygonAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_MultiSurface type

An ST_MultiSurface is a collection of zero or more ST_Surface values, and all of the surfaces are within the spatial reference system.

Direct supertype

- "ST_GeomCollection type" on page 82

Direct subtypes

- "ST_MultiPolygon type" on page 244

Constructor

- "ST_MultiSurface constructor" on page 251

Methods

- "ST_Area method for type ST_MultiSurface" on page 255
- "ST_Centroid method for type ST_MultiSurface" on page 255
- "ST_MultiSurfaceAggr method for type ST_MultiSurface" on page 256
- "ST_Perimeter method for type ST_MultiSurface" on page 257
- "ST_PointOnSurface method for type ST_MultiSurface" on page 258
- All methods of "ST_GeomCollection type" on page 82 can also be called on a ST_MultiSurface type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_MultiSurface type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5

ST_MultiSurface constructor

Constructs a multi surface

Overload list

Name	Description
"ST_MultiSurface() constructor" on page 251	Constructs a multi surface representing the empty set.
"ST_MultiSurface(LONG VARCHAR[, INT]) constructor" on page 251	Constructs a multi surface from a text representation.
"ST_MultiSurface(LONG BINARY[, INT]) constructor" on page 252	Constructs a multi surface from WKB.
"ST_MultiSurface(ST_Surface,...) constructor" on page 253	Constructs a multi-surface from a list of surface values.
"ST_MultiSurface(ST_MultiCurve[, VARCHAR(128)]) constructor" on page 254	Creates a multi-surface from a multicurve containing exterior rings and an optional list of interior rings.

ST_MultiSurface() constructor

Constructs a multi surface representing the empty set.

Syntax

NEW ST_MultiSurface()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_MultiSurface().ST_IsEmpty()
```

ST_MultiSurface(LONG VARCHAR[, INT]) constructor

Constructs a multi surface from a text representation.

Syntax

NEW ST_MultiSurface(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-representation	LONG VARCHAR	A string containing the text representation of a multi surface. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi surface from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.2

Example

The following returns MultiSurface (((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2, -2 2, 2 2, 2 -2, -2 -2)), ((10 -5, 15 5, 5 5, 10 -5)))

```
SELECT NEW ST_MultiSurface('MultiSurface (((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2,
-2 2, 2 2, 2 -2, -2 -2)), ((10 -5, 15 5, 5 5, 10 -5)))')
```

ST_MultiSurface(LONG BINARY[, INT]) constructor

Constructs a multi surface from WKB.

Syntax

NEW ST_MultiSurface(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	A string containing the binary representation of an multi surface. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a multi surface from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.2

Example

The following returns MultiSurface (CurvePolygon (CircularString (0 0, 10 0, 10 10, 0 10, 0 0)))

```
SELECT NEW
ST_MultiSurface(0x010c00000001000000010a0000000100000001080000000500000000000
00000000000000000000000000000000000000002440000000000000000000000000000244000
00000000002440000000000000000000000000000244000000000000000000000000000000000
0)
```

ST_MultiSurface(ST_Surface,...) constructor

Constructs a multi-surface from a list of surface values.

Syntax

NEW ST_MultiSurface(*surface1*,[*surface2*,...,*surfaceN*])

Parameters

Name	Type	Description
surface1	ST_Surface	The first surface value of the multi-surface.
surface2,...,surfaceN	ST_Surface	Additional surface values of the multi-surface.

Remarks

Constructs a multi-surface from a list of surface values. All of the supplied surface values must have the same SRID, and the multi-surface is constructed with this common SRID.

All of the supplied surface values must have the same answer for Is3D and IsMeasured. The multi-surface is 3D if all of the surface values are 3D, and the multi-surface is measured if all of the surface values are measured.

Note
By default, ST_MultiSurface uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns a multi-surface equivalent to `'MultiSurface (((0 0, 0 1, 1 1, 1 0, 0 0)))'`

```
SELECT NEW ST_MultiSurface( NEW ST_Polygon('Polygon ((0 0, 0 1, 1 1, 1 0, 0
0))' )  )
```


The following example returns the result `MultiSurface (((0 0, 1 0, 1 1, 0 1, 0 0)), ((5 5, 10 5, 10 10, 5 10, 5 5)))`.

```
SELECT NEW ST_MultiSurface(
        NEW ST_Polygon('Polygon ((0 0, 0 1, 1 1, 1 0, 0 0))' ),
        NEW ST_Polygon('Polygon ((5 5, 5 10, 10 10, 10 5, 5 5))' )  )
```

ST_MultiSurface(ST_MultiCurve[, VARCHAR(128)]) constructor

Creates a multi-surface from a multicurve containing exterior rings and an optional list of interior rings.

Syntax

NEW ST_MultiSurface(*multi-curve*[, *polygon-format*])

Parameters

Name	Type	Description
multi-curve	ST_MultiCurve	A multicurve value containing exterior rings and (optionally) a set of interior rings.
polygon-format	VARCHAR(128)	A string with the polygon format to use when interpreting the provided curves. Valid formats are 'CounterClockwise', 'Clockwise', and 'EvenOdd'

Remarks

Creates a multi-surface from a multicurve containing exterior rings and an optional list of interior rings. The multicurve may contain any curve type.

If specified, the *polygon-format* parameter selects the algorithm the server uses to determine whether a ring is an exterior or interior ring. If not specified, the polygon format of the spatial reference system is used.

For additional information on *polygon-format*, see "POLYGON FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Note
By default, ST_MultiSurface uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns MultiSurface (CurvePolygon ((-4 -4, 4 -4, 4 4, -4 4, -4 -4), (-2 1, -3 3, -1 3, -2 1)), CurvePolygon ((6 -4, 14 -4, 14 4, 6 4, 6 -4), CircularString (9 -1, 9 1, 11 1, 11 -1, 9 -1)))


```
SELECT NEW ST_MultiSurface(NEW ST_MultiCurve ('MultiCurve ((-4 -4, 4 -4, 4 4,
-4 4, -4 -4), (-2 1, -3 3, -1 3, -2 1), (6 -4, 14 -4, 14 4, 6 4, 6 -4),
CircularString (9 -1, 9 1, 11 1, 11 -1, 9 -1))'))
```

ST_Area method for type ST_MultiSurface

Computes the area of the multi-surface in the specified units.

Syntax

multisurface-expression.**ST_Area**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VARCHAR(128)	The units in which the area should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the area of the multi-surface.

Remarks

Computes the area of the multi-surface in the specified units. The area of the multi-surface is the sum of the areas of the contained surfaces.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Area method for type ST_Surface" on page 289

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.3

ST_Centroid method for type ST_MultiSurface

Computes the ST_Point that is the mathematical centroid of the multi-surface.

Syntax

multisurface-expression.**ST_Centroid**()

Returns

- **ST_Point** If the multi-surface is the empty set, returns NULL. Otherwise, returns the mathematical centroid of the surface.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *multisurface-expression*.

Remarks

Computes the ST_Point that is the mathematical centroid of the multi-surface. Note that this point will not necessarily be a point on the surface.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Centroid method for type ST_Surface" on page 289
- "ST_PointOnSurface method for type ST_MultiSurface" on page 258

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.5

ST_MultiSurfaceAggr method for type ST_MultiSurface

Returns a multisurface containing all of the surfaces in a group

Syntax

ST_MultiSurface::**ST_MultiSurfaceAggr**(*geometry-column*[**ORDER BY** *order-by-expression* [**ASC** | **DESC**], ...])

Parameters

Name	Type	Description
geometry-column	ST_Surface	The geometry values to generate the collection. Typically this is a column.

Returns

- **ST_MultiSurface** Returns a multisurface that contains all of the geometries in a group.

  The spatial reference system identifier of the result is the same as that for the first parameter.

Remarks

The ST_MultiSurfaceAggr aggregate function can be used to combine a group of surfaces into a single collection. All of the geometries to be combined must have both the same SRID and the same coordinate dimension.

Rows where the argument is NULL are not included.

Returns NULL for an empty group or a group containing no non-NULL values.

The resulting ST_MultiSurface has the same coordinate dimension as each surfaces.

The optional ORDER BY clause can be used to arrange the elements in a particular order so that ST_GeometryN returns them in the desired order. If this ordering is not relevant, it is more efficient to not specify an ordering. In that case, the ordering of elements depends on the access plan selected by the query optimizer.

> **Note**
> By default, ST_MultiSurfaceAggr uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_Perimeter method for type ST_MultiSurface

Computes the perimeter of the multi-surface in the specified units.

Syntax

multisurface-expression.**ST_Perimeter**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VARCHAR(128)	The units in which the perimeter should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the perimeter of the multi-surface.

Remarks

The ST_Perimeter method returns the length of the perimeter of a multi-surface in the units identified by the *unit-name* parameter. If the multi-surface is empty, then NULL is returned.

If the multi-surface contains Z values, these are not considered when computing the perimeter of the geometry.

The perimeter of a polygon includes the length of all rings (exterior and interior).

> **Note**
> If the *multisurface-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Perimeter uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.4

Example

The following example creates a multi-surface containing two polygons and uses ST_Perimeter to find the length of the perimeter, returning the result 44.

```
SELECT NEW ST_MultiSurface( NEW ST_Polygon('Polygon((0 0, 1 0, 1 1,0 1, 0
0))')
              , NEW ST_Polygon('Polygon((10 10, 20 10, 20 20,10 20, 10
10))') )
        .ST_Perimeter()
```

The following example creates a multi-surface containing two polygons and an example unit of measure (example_unit_halfmetre). The ST_Perimeter finds the length of the perimeter, returning the value 88.0.

```
CREATE SPATIAL UNIT OF MEASURE IF NOT EXISTS  "example_unit_halfmetre" TYPE
LINEAR CONVERT USING .5;
SELECT NEW ST_MultiSurface( NEW ST_Polygon('Polygon((0 0, 1 0, 1 1,0 1, 0
0))')
              , NEW ST_Polygon('Polygon((10 10, 20 10, 20 20,10 20, 10
10))') )
        .ST_Perimeter('example_unit_halfmetre');
```

ST_PointOnSurface method for type ST_MultiSurface

Returns a point that is guaranteed to be on a surface in the multi-surface

Syntax

multisurface-expression.**ST_PointOnSurface**()

Returns

- **ST_Point** If the multi-surface is the empty set, returns NULL. Otherwise, returns an ST_Point value guaranteed to spatially intersect the ST_MultiSurface value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *multisurface-expression*.

Remarks

Returns a point that is in the interior of one of the surfaces of a multi-surface.

> **Note**
> If the *multisurface-expression* contains circular strings, then these are interpolated to line strings.

See also

- “ST_PointOnSurface method for type ST_Surface” on page 291
- “ST_Centroid method for type ST_MultiSurface” on page 255

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.6

ST_Point type

The ST_Point type is a 0-dimensional geometry and represents a single location.

Direct supertype

- “ST_Geometry type” on page 88

Constructor

- “ST_Point constructor” on page 259

Methods

- “ST_Lat method for type ST_Point” on page 263
- “ST_Long method for type ST_Point” on page 265
- “ST_M method for type ST_Point” on page 267
- “ST_X method for type ST_Point” on page 268
- “ST_Y method for type ST_Point” on page 270
- “ST_Z method for type ST_Point” on page 272
- All methods of “ST_Geometry type” on page 88 can also be called on a ST_Point type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1

ST_Point constructor

Constructs a point

Note
When creating an ST_Point value from coordinates, the overload that is picked is not always predictable. For example, the expression "NEW ST_Point(1,2,3)" creates a 2D point with x=1, y=2 and SRID=3. The expression "NEW ST_Point(1,2,3.0)" creates a 3D point with z=3.0.

Overload list

Name	Description
"ST_Point() constructor" on page 260	Constructs a point representing the empty set.
"ST_Point(LONG VARCHAR[, INT]) constructor" on page 260	Constructs a point from a text representation.
"ST_Point(LONG BINARY[, INT]) constructor" on page 261	Constructs a point from WKB.
"ST_Point(DOUBLE,DOUBLE[, INT]) constructor" on page 262	Constructs a 2D point from x,y coordinates.
"ST_Point(DOUBLE,DOUBLE,DOUBLE[, INT]) constructor" on page 262	Constructs a 3D point from x,y,z coordinates.
"ST_Point(DOUBLE,DOUBLE,DOUBLE,DOUBLE[, INT]) constructor" on page 263	Constructs a 3D, measured point from x,y,z coordinates and a measure value

ST_Point() constructor

Constructs a point representing the empty set.

Syntax

NEW ST_Point()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_Point().ST_IsEmpty()
```

ST_Point(LONG VARCHAR[, INT]) constructor

Constructs a point from a text representation.

Syntax

NEW ST_Point(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a point. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a point from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.2

Example

The following returns Point (10 20)

```
SELECT NEW ST_Point('Point (10 20)')
```

ST_Point(LONG BINARY[, INT]) constructor

Constructs a point from WKB.

Syntax

NEW ST_Point(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an point. The input can be in any supported binary input format, including WKB or EWKB.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a point from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.2

Example

The following returns Point (10 20)

```
SELECT NEW ST_Point(0x010100000000000000000024400000000000003440)
```

ST_Point(DOUBLE,DOUBLE[, INT]) constructor

Constructs a 2D point from x,y coordinates.

Syntax

NEW ST_Point(*x*,*y*[, *srid*])

Parameters

Name	Type	Description
x	DOUBLE	The x-coordinate value.
y	DOUBLE	The y-coordinate value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.2

Example

The following returns Point (10 20)

```
SELECT NEW ST_Point(10.0,20.0,0)
```

ST_Point(DOUBLE,DOUBLE,DOUBLE[, INT]) constructor

Constructs a 3D point from x,y,z coordinates.

Syntax

NEW ST_Point(*x*,*y*,*z*[, *srid*])

Parameters

Name	Type	Description
x	DOUBLE	The x-coordinate value.
y	DOUBLE	The y-coordinate value.
z	DOUBLE	The z-coordinate value.

Name	Type	Description
srid	INT	The SRID of the result. If not specified, the default is 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.2

Example

The following returns Point Z (10 20 100)

```
SELECT NEW ST_Point(10.0,20.0,100.0,0)
```

ST_Point(DOUBLE,DOUBLE,DOUBLE,DOUBLE[, INT]) constructor

Constructs a 3D, measured point from x,y,z coordinates and a measure value

Syntax

NEW ST_Point(*x*,*y*,*z*,*m*[, *srid*])

Parameters

Name	Type	Description
x	DOUBLE	The x-coordinate value.
y	DOUBLE	The y-coordinate value.
z	DOUBLE	The z-coordinate value.
m	DOUBLE	The measure value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.2

Example

The following returns Point ZM (10 20 100 1224)

```
SELECT NEW ST_Point(10.0,20.0,100.0,1224.0,0)
```

ST_Lat method for type ST_Point

Returns the latitude coordinate of the ST_Point value.

Overload list

Name	Description
"ST_Lat() method for type ST_Point" on page 264	Returns the latitude coordinate of the ST_Point value.
"ST_Lat(DOUBLE) method for type ST_Point" on page 264	Returns a copy of the point with the latitude coordinate set to the specified latitude value.

ST_Lat() method for type ST_Point

Returns the latitude coordinate of the ST_Point value.

Note
If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Lat uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Lat**()

Returns

- **DOUBLE** Returns the latitude coordinate of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example gives an error because the spatial reference system identified by 0 is not a geographic spatial reference system.

```
SELECT NEW ST_Point( 10.0, 20.0, 0 ).ST_Lat()
```

The following example returns the result `20.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 4326 ).ST_Lat()
```

ST_Lat(DOUBLE) method for type ST_Point

Returns a copy of the point with the latitude coordinate set to the specified latitude value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Lat uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Lat**(*latitude-val*)

Parameters

Name	Type	Description
latitude-val	DOUBLE	The new latitude value.

Returns

- **ST_Point** Returns a copy of the point with the latitude set to the specified value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_Long method for type ST_Point

Returns the longitude coordinate of the ST_Point value.

Overload list

Name	Description
"ST_Long() method for type ST_Point" on page 265	Returns the longitude coordinate of the ST_Point value.
"ST_Long(DOUBLE) method for type ST_Point" on page 266	Returns a copy of the point with the longitude coordinate set to the specified longitude value.

ST_Long() method for type ST_Point

Returns the longitude coordinate of the ST_Point value.

Note
If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Long uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Long**()

Returns

- **DOUBLE** Returns the longitude coordinate of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example gives an error because the spatial reference system identified by 0 is not a geographic spatial reference system.

```
SELECT NEW ST_Point( 10.0, 20.0, 0 ).ST_Lon()
```

The following example returns the result `10.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 4326 ).ST_Long()
```

ST_Long(DOUBLE) method for type ST_Point

Returns a copy of the point with the longitude coordinate set to the specified longitude value.

Note
If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Long uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Long**(*longitude-val*)

Parameters

Name	Type	Description
longitude-val	DOUBLE	The new longitude value.

Returns

- **ST_Point** Returns a copy of the point with the longitude set to the specified value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

ST_M method for type ST_Point

Retrieves or modifies the m coordinate value of a point.

Overload list

Name	Description
"ST_M() method for type ST_Point" on page 267	Returns the m value of the ST_Point value.
"ST_M(DOUBLE) method for type ST_Point" on page 268	Returns a copy of the point with the m coordinate set to the specified mcoord value.

ST_M() method for type ST_Point

Returns the m value of the ST_Point value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_M uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_M**()

Returns

- **DOUBLE** Returns the m value of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.6

Example

The following example returns the result `40.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 30.0, 40.0, 0 ).ST_M()
```

ST_M(DOUBLE) method for type ST_Point

Returns a copy of the point with the m coordinate set to the specified mcoord value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_M uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_M**(*mcoord*)

Parameters

Name	Type	Description
mcoord	DOUBLE	The new m-coordinate value.

Returns

- **ST_Point** Returns a copy of the point with the m coordinate set to the specified mcoord value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.6

ST_X method for type ST_Point

Retrieves or modifies the x coordinate value of a point.

Overload list

Name	Description
"ST_X() method for type ST_Point" on page 269	Returns the x coordinate of the ST_Point value.
"ST_X(DOUBLE) method for type ST_Point" on page 269	Returns a copy of the point with the x coordinate set to the specified xcoord value.

ST_X() method for type ST_Point

Returns the x coordinate of the ST_Point value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_X uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_X**()

Returns

- **DOUBLE** Returns the x coordinate of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.3

Example

The following example returns the result `10.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 30.0, 40.0, 0 ).ST_X()
```

ST_X(DOUBLE) method for type ST_Point

Returns a copy of the point with the x coordinate set to the specified xcoord value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_X uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_X**(*xcoord*)

Parameters

Name	Type	Description
xcoord	DOUBLE	The new x-coordinate value.

Returns

- **ST_Point** Returns a copy of the point with the x coordinate set to the specified xcoord value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.3

ST_Y method for type ST_Point

Retrieves or modifies the y coordinate value of a point.

Overload list

Name	Description
"ST_Y() method for type ST_Point" on page 270	Returns the y coordinate of the ST_Point value.
"ST_Y(DOUBLE) method for type ST_Point" on page 271	Returns a copy of the point with the y coordinate set to the specified ycoord value.

ST_Y() method for type ST_Point

Returns the y coordinate of the ST_Point value.

Note
If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Y uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Y**()

Returns

- **DOUBLE** Returns the y coordinate of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.4

Example

The following example returns the result `20.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 30.0, 40.0, 0 ).ST_Y()
```

ST_Y(DOUBLE) method for type ST_Point

Returns a copy of the point with the y coordinate set to the specified ycoord value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Y uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Y**(*ycoord*)

Parameters

Name	Type	Description
ycoord	DOUBLE	The new y-coordinate value.

Returns

- **ST_Point** Returns a copy of the point with the y coordinate set to the specified ycoord value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.4

ST_Z method for type ST_Point

Retrieves or modifies the z coordinate value of a point.

Overload list

Name	Description
"ST_Z() method for type ST_Point" on page 272	Returns the z coordinate of the ST_Point value.
"ST_Z(DOUBLE) method for type ST_Point" on page 273	Returns a copy of the point with the z coordinate set to the specified zcoord value.

ST_Z() method for type ST_Point

Returns the z coordinate of the ST_Point value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Z uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Z**()

Returns

- **DOUBLE** Returns the z coordinate of the ST_Point value.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.4

Example

The following example returns the result `30.0`.

```
SELECT NEW ST_Point( 10.0, 20.0, 30.0, 40.0, 0 ).ST_Z()
```


ST_Z(DOUBLE) method for type ST_Point

Returns a copy of the point with the z coordinate set to the specified zcoord value.

> **Note**
> If the *point-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

> **Note**
> By default, ST_Z uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

point-expression.**ST_Z**(*zcoord*)

Parameters

Name	Type	Description
zcoord	DOUBLE	The new z-coordinate value.

Returns

- **ST_Point** Returns a copy of the point with the z coordinate set to the specified zcoord value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *point-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.5

ST_Polygon type

An ST_Polygon is an ST_CurvePolygon that is formed with interior and exterior rings that are linear rings.

Direct supertype

- "ST_CurvePolygon type" on page 74

Constructor

- "ST_Polygon constructor" on page 274

Methods

- "ST_ExteriorRing method for type ST_Polygon" on page 279
- "ST_InteriorRingN method for type ST_Polygon" on page 280
- All methods of "ST_CurvePolygon type" on page 74 can also be called on a ST_Polygon type.
- All methods of "ST_Surface type" on page 288 can also be called on a ST_Polygon type.
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_Polygon type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3

ST_Polygon constructor

Constructs a polygon

Overload list

Name	Description
"ST_Polygon() constructor" on page 274	Constructs a polygon representing the empty set.
"ST_Polygon(LONG VARCHAR[, INT]) constructor" on page 275	Constructs a polygon from a text representation.
"ST_Polygon(LONG BINARY[, INT]) constructor" on page 275	Constructs a polygon from WKB.
"ST_Polygon(ST_Point,ST_Point) constructor" on page 276	Creates an axis-aligned rectangle from two points representing the lower-left and upper-right corners.
"ST_Polygon(ST_MultiLineString[, VARCHAR(128)]) constructor" on page 277	Creates a polygon from a multilinestring containing an exterior ring and an optional list of interior rings.
"ST_Polygon(ST_LineString,...) constructor" on page 278	Creates a polygon from a linestring representing the exterior ring and an optional list of linestrings representing interior rings.

ST_Polygon() constructor

Constructs a polygon representing the empty set.

Syntax

NEW ST_Polygon()

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Standard feature

Example

The following returns 1, indicating the value is empty.

```
SELECT new ST_Polygon().ST_IsEmpty()
```

ST_Polygon(LONG VARCHAR[, INT]) constructor

Constructs a polygon from a text representation.

Syntax

NEW ST_Polygon(*text-representation*[, *srid*])

Parameters

Name	Type	Description
text-represen-tation	LONG VARCHAR	A string containing the text representation of a polygon. The input can be in any supported text input format, including WKT or EWKT.
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a polygon from a character string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.2

Example

The following returns Polygon ((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2, -2 2, 2 2, 2 -2, -2 -2))

```
SELECT NEW ST_Polygon('Polygon ((-5 -5, 5 -5, 0 5, -5 -5), (-2 -2, -2 2, 2 2,
2 -2, -2 -2))')
```

ST_Polygon(LONG BINARY[, INT]) constructor

Constructs a polygon from WKB.

Syntax

NEW ST_Polygon(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BI-NARY	A string containing the binary representation of an polygon. The input can be in any supported binary input format, including WKB or EWKB.

Name	Type	Description
srid	INT	The SRID of the result. If not specified, the default is 0.

Remarks

Constructs a polygon from a binary string representation. The database server determines the input format by inspecting the provided string.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.2

Example

The following returns Polygon ((10 -5, 15 5, 5 5, 10 -5))

```
SELECT NEW
ST_Polygon(0x0103000000010000000400000000000000000000244000000000000014c0000000
0000002e40000000000000144000000000000014400000000000001440000000000000002440000
00000000014c0)
```

ST_Polygon(ST_Point,ST_Point) constructor

Creates an axis-aligned rectangle from two points representing the lower-left and upper-right corners.

Syntax

NEW ST_Polygon(*pmin*,*pmax*)

Parameters

Name	Type	Description
pmin	ST_Point	A point that is the lower-left corner of the rectangle.
pmax	ST_Point	A point that is the upper-right corner of the rectangle.

Remarks

Returns a rectangle defined as the envelope of two points.

The constructor is equivalent to the following: `NEW ST_MultiPoint( pmin, pmax, pmin.ST_SRID() ).ST_Envelope()`

> **Note**
> By default, ST_Polygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following returns Polygon ((0 0, 4 0, 4 10, 0 10, 0 0))

```
SELECT NEW ST_Polygon(NEW ST_Point(0.0, 0.0), NEW ST_Point(4.0, 10.0))
```

ST_Polygon(ST_MultiLineString[, VARCHAR(128)]) constructor

Creates a polygon from a multilinestring containing an exterior ring and an optional list of interior rings.

Syntax

NEW ST_Polygon(*multi-linestring*[, *polygon-format*])

Parameters

Name	Type	Description
multi-line-string	ST_MultiLine-String	A multilinestring value containing an exterior ring and (optional-ly) a set of interior rings.
polygon-for-mat	VARCHAR(128)	A string with the polygon format to use when interpreting the pro-vided linestrings. Valid formats are 'CounterClockwise', 'Clock-wise', and 'EvenOdd'

Remarks

Creates a polygon from a multilinestring containing an exterior ring and an optional list of interior rings. The multilinestring must contain only linear rings.

If specified, the *polygon-format* parameter selects the algorithm the server uses to determine whether a ring is an exterior or interior ring. If not specified, the polygon format of the spatial reference system is used.

For additional information on *polygon-format*, see “POLYGON FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

> **Note**
> By default, ST_Polygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see “STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement” [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.2

Example

The following returns Polygon ((-5 -1, 5 -1, 0 9, -5 -1), (-2 0, 0 4, 2 0, -2 0)) (a triangle with a triangular hole).

```
SELECT NEW ST_Polygon(
    NEW ST_MultiLineString ('MultiLineString ((-5 -1, 5 -1, 0 9, -5 -1), (-2
0, 0 4, 2 0, -2 0))'))
```

ST_Polygon(ST_LineString,...) constructor

Creates a polygon from a linestring representing the exterior ring and an optional list of linestrings representing interior rings.

Syntax

NEW ST_Polygon(*exterior-ring*,[*interior-ring1*,...,*interior-ringN*])

Parameters

Name	Type	Description
exterior-ring	ST_LineString	The exterior ring of the polygon
interior-ring1,...,interior-ringN	ST_LineString	Interior rings of the polygon

Remarks

Creates a polygon from a linestring representing the exterior ring and a list (possibly empty) of linestrings representing interior rings. All of the specified linestring values must have the same SRID. The resulting polygon is constructed with this common SRID.

All of the supplied linestrings must be non-empty and have the same answer for Is3D and IsMeasured. The polygon is 3D if all of the linestrings are 3D, and the polygon is measured if all of the linestrings are measured.

> **Note**
> By default, ST_Polygon uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

The ability to specify a varying length list of interior rings is a vendor extension.

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.2

Example

The following returns Polygon ((-5 -1, 5 -1, 0 9, -5 -1), (-2 0, 0 4, 2 0, -2 0)) (a triangle with a triangular hole).


```
SELECT NEW ST_Polygon(
    NEW ST_LineString ('LineString (-5 -1, 5 -1, 0 9, -5 -1)'),
    NEW ST_LineString ('LineString (-2 0, 0 4, 2 0, -2 0)'))
```

ST_ExteriorRing method for type ST_Polygon

Retrieve or modify the exterior ring.

Overload list

Name	Description
"ST_ExteriorRing() method for type ST_Polygon" on page 279	Returns the exterior ring of the polygon.
"ST_ExteriorRing(ST_Curve) method for type ST_Polygon" on page 279	Changes the exterior ring of the polygon.

ST_ExteriorRing() method for type ST_Polygon

Returns the exterior ring of the polygon.

> **Note**
> By default, ST_ExteriorRing uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

polygon-expression.**ST_ExteriorRing**()

Returns

- **ST_LineString**   Returns the exterior ring of the polygon.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *polygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)**   8.3.3

ST_ExteriorRing(ST_Curve) method for type ST_Polygon

Changes the exterior ring of the polygon.

Note
By default, ST_ExteriorRing uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

polygon-expression.**ST_ExteriorRing**(*curve*)

Parameters

Name	Type	Description
curve	ST_Curve	The new exterior ring of the polygon. This must be a linear ring value.

Returns

- **ST_Polygon** Returns a copy of the polygon with specified exterior ring.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *polygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.3

ST_InteriorRingN method for type ST_Polygon

Returns the *n*th interior ring in the polygon.

Note
By default, ST_InteriorRingN uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Syntax

polygon-expression.**ST_InteriorRingN**(*n*)

Parameters

Name	Type	Description
n	INT	The position of the element to return, from 1 to *polygon-expression*.ST_NumInteriorRing().

Returns

- **ST_LineString** Returns the *n*th interior ring in the polygon.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *polygon-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.5

ST_SpatialRefSys type

The ST_SpatialRefSys type defines routines for working with spatial reference systems.

Methods

- "ST_CompareWKT method for type ST_SpatialRefSys" on page 281
- "ST_FormatTransformDefinition method for type ST_SpatialRefSys" on page 282
- "ST_FormatWKT method for type ST_SpatialRefSys" on page 283
- "ST_GetUnProjectedTransformDefinition method for type ST_SpatialRefSys" on page 284
- "ST_ParseWKT method for type ST_SpatialRefSys" on page 285
- "ST_TransformGeom method for type ST_SpatialRefSys" on page 286
- "ST_World method for type ST_SpatialRefSys" on page 287

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 13.1

ST_CompareWKT method for type ST_SpatialRefSys

Compares two spatial reference system definitions.

Syntax

ST_SpatialRefSys::**ST_CompareWKT**(*transform-definition-1*,*transform-definition-2*)

Parameters

Name	Type	Description
transform-definition-1	LONG VARCHAR	The first spatial reference system definition text
transform-definition-2	LONG VARCHAR	The second spatial reference system definition text

Returns

- **BIT** Returns 1 if the two spatial reference systems are logically equivalent, otherwise 0.

Remarks

Determines if two spatial reference systems (defined by WKT) are logically equivalent. The systems are considered logically equal if they are defined by the same authority with the same identifier or if the strings are exactly equal.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example shows that two spatial reference systems are considered equal even though they have different names:

```
SELECT  ST_SpatialRefSys::ST_CompareWKT(
    'GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]'
,   'GEOGCS["WGS 84 alternate name",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]'
) Considered_Equal
```

The following example shows two spatial reference systems that are considered non-equal because they are defined by different authorities:

```
SELECT  ST_SpatialRefSys::ST_CompareWKT(
    'GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]'
,   'GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["AnotherAuthority","4
326"]]'
) Considered_NotEqual
```

ST_FormatTransformDefinition method for type ST_SpatialRefSys

Returns a formatted copy of the transform definition.

Syntax

ST_SpatialRefSys::**ST_FormatTransformDefinition**(*transform-definition*)

Parameters

Name	Type	Description
transform-definition	LONG VARCHAR	The spatial reference system transform definition text

Returns

- **LONG VARCHAR** Returns a text string defining the transform definition

Remarks

Returns a formatted copy of the transform definition.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `+proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs +towgs84=0,0,0 +no_defs`.

```
SELECT  ST_SpatialRefSys::ST_FormatTransformDefinition('+proj=longlat
+ellps=WGS84 +datum=WGS84 +no_defs')
```

ST_FormatWKT method for type ST_SpatialRefSys

Returns a formatted copy of the WKT definition.

Syntax

ST_SpatialRefSys::**ST_FormatWKT**(*definition*)

Parameters

Name	Type	Description
definition	LONG VARCHAR	The spatial reference system definition text

Returns

- **LONG VARCHAR** Returns a text string defining the spatial reference system in WKT.

Remarks

Returns a formatted copy of the WKT spatial reference system definition.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `GEOGCS["WGS 84", DATUM["WGS_1984", SPHEROID["WGS 84",6378137,298.257223563,AUTHORITY["EPSG","7030"]], AUTHORITY["EPSG","6326"]], PRIMEM["Greenwich", 0,AUTHORITY["EPSG","8901"]], UNIT["degree", 0.01745329251994328,AUTHORITY["EPSG","9122"]], AUTHORITY["EPSG","4326"]]`.

```
SELECT  ST_SpatialRefSys::ST_FormatWKT('GEOGCS["WGS
84",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]')
```

ST_GetUnProjectedTransformDefinition method for type ST_SpatialRefSys

Returns the transform definition of the spatial reference system that is the source of the projection.

Syntax

ST_SpatialRefSys::**ST_GetUnProjectedTransformDefinition**(*transform-definition*)

Parameters

Name	Type	Description
transform-definition	LONG VARCHAR	The spatial reference system transform definition text

Returns

- **LONG VARCHAR** Returns a text string defining the transform definition of the unprojected spatial reference system.

Remarks

If the *transform-definition* parameter defines a projected spatial reference system, returns the definition of the source spatial reference system.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `+proj=latlong +a=6371000 +b=6371000 +no_defs`.

```
SELECT ST_SpatialRefSys::ST_GetUnProjectedTransformDefinition( '+proj=robin
+lon_0=0 +x_0=0 +y_0=0 +a=6371000 +b=6371000 +units=m  no_defs' )
```


ST_ParseWKT method for type ST_SpatialRefSys

Retrieves a named element from the WKT definition of a spatial reference system.

Syntax

ST_SpatialRefSys::**ST_ParseWKT**(*element*,*srs-text*)

Parameters

Name	Type	Description
element	VARCHAR(128)	The element to retrieve from the WKT. The following named elements may be retrieved: ● **srs_name** The name of the spatial reference system ● **srs_type** The coordinate system type. ● **organization** The name of the organization that defined the spatial reference system. ● **organization_id** The integer identifier assigned by the organization that defined the spatial reference system. ● **linear_unit_of_measure** The name of the linear unit of measure. ● **linear_unit_of_measure_factor** The conversion factor for the linear unit of measure. ● **angular_unit_of_measure** The name of the angular unit of measure. ● **angular_unit_of_measure_factor** The conversion factor for the angular unit of measure.
srs-text	LONG VARCHAR	The spatial reference system definition text

Returns

- **LONG VARCHAR** Retrieves a named element from the WKT definition of a spatial reference system.

Remarks

Retrieves a named element from the WKT definition of a spatial reference system. If the WKT does not define the named element, NULL is returned.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns a result with one row for each of the named elements.

```
with V(element,srs_text) as (
    SELECT row_value as element, 'GEOGCS["WGS
84",DATUM["WGS_1984",SPHEROID["WGS 84",
6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]],PRI
MEM["Greenwich",0,AUTHORITY["EPSG","8901"]],UNIT["degree",
0.01745329251994328,AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]' as
srs_text
    FROM
sa_split_list('srs_name,srs_type,organization,organization_id,linear_unit_of_
measure,linear_unit_of_measure_factor,angular_unit_of_measure,angular_unit_of
_measure_factor') D
)
SELECT element, ST_SpatialRefSys::ST_ParseWKT( element, srs_text ) parsed
FROM V
```

The example returns the following result set:

element	parsed
srs_name	WGS 84
srs_type	GEOGRAPHIC
organization	EPSG
organization_id	4326
linear_unit_of_measure	NULL
linear_unit_of_measure_factor	NULL
angular_unit_of_measure	degree
angular_unit_of_measure_factor	.017453292519943282

ST_TransformGeom method for type ST_SpatialRefSys

Returns the geometry transformed using the given transform definition.

Syntax

ST_SpatialRefSys::**ST_TransformGeom**(*geom*,*target-transform-definition*[, *source-transform-definition*])

Parameters

Name	Type	Description
geom	ST_Geometry	The geometry to be transformed

Name	Type	Description
target-transform-definition	LONG VARCHAR	The target spatial reference system transform definition text
source-transform-definition	LONG VARCHAR	The source spatial reference system transform definition text. If not specified, the transform definition from the spatial reference system of the *geom* parameter is used.

Returns

- **ST_Geometry** Returns the input geometry transformed using the given transform definition.

  The spatial reference system identifier of the result is sa_planar_unbounded (with SRID 2147483646).

Remarks

The ST_TransformGeom method transforms a single geometry given the transform definition of the destination. The transformation is performed using the PROJ.4 library. This method can be used in select situations when the appropriate spatial reference systems have not yet been created in the database. If the appropriate spatial reference systems are available, the ST_Transform method is often more appropriate.

Transformations from a lat/long system to a Cartesian system can be problematic for polar points. If the database server is unable to transform a point close to the North or South pole, the latitude value of the point is shifted a small distance (slightly more than 1e-10 radians) away from the pole, and along the same longitude, so that the transformation can succeed.

See also

- "ST_Transform method for type ST_Geometry" on page 208

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Point (-5387692.968586 4763459.253243)`.

```
SELECT  ST_SpatialRefSys::ST_TransformGeom( NEW ST_Point(-63.57,44.65,4326),
'+proj=robin +lon_0=0 +x_0=0 +y_0=0 +a=6371000 +b=6371000 +units=m
no_defs' ).ST_AsText('DecimalDigits=6')
```

ST_World method for type ST_SpatialRefSys

Returns a geometry that represents all of the points in the spatial reference system.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

Syntax

ST_SpatialRefSys::**ST_World**(*srid*)

Parameters

Name	Type	Description
srid	INT	The SRID to use for the result.

Returns

- **ST_Surface** Returns a geometry that represents all of the points in the spatial reference system identified by the *srid* parameter.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** Vendor extension

Example

The following example returns the result `Polygon ((-1000000 -1000000, 1000000 -1000000, 1000000 1000000, -1000000 1000000, -1000000 -1000000))`.

```
SELECT ST_SpatialRefSys::ST_World(0).ST_AsText()
```

ST_Surface type

The ST_Surface type is a supertype for 2-dimensional geometry types. The ST_Surface type is not instantiable.

Direct supertype

- "ST_Geometry type" on page 88

Direct subtypes

- "ST_CurvePolygon type" on page 74

Methods

- "ST_Area method for type ST_Surface" on page 289
- "ST_Centroid method for type ST_Surface" on page 289
- "ST_IsWorld method for type ST_Surface" on page 290
- "ST_Perimeter method for type ST_Surface" on page 290
- "ST_PointOnSurface method for type ST_Surface" on page 291
- All methods of "ST_Geometry type" on page 88 can also be called on a ST_Surface type.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1

ST_Area method for type ST_Surface

Calculates the area of a surface in the specified units.

Syntax

surface-expression.**ST_Area**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VARCHAR(128)	The units in which the length should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the area of the surface.

Remarks

The ST_Area method computes the area of a surface. The units used to represent the area are based on the specified linear unit of measure. For example, if the specified linear unit of measure is feet, the unit used for area is square feet.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_Area method for type ST_MultiSurface" on page 255

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1.2

ST_Centroid method for type ST_Surface

Returns the ST_Point value that is the mathematical centroid of the surface value.

Syntax

surface-expression.**ST_Centroid**()

Returns

- **ST_Point** If the surface is the empty set, returns NULL. Otherwise, returns the mathematical centroid of the surface.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *surface-expression*.

Remarks

Returns the ST_Point value that is the mathematical centroid of the surface value. Note that this point will not necessarily be a point on the surface.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

See also

- "ST_PointOnSurface method for type ST_Surface" on page 291

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1.4

ST_IsWorld method for type ST_Surface

Test if the ST_Surface covers the entire space.

> **Note**
> This method can not be used with geometries in round-Earth spatial reference system.

Syntax

surface-expression.**ST_IsWorld**()

Returns

- **BIT** Returns 1 if the surface covers the entire space, otherwise 0.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1.6

ST_Perimeter method for type ST_Surface

Calculates the perimeter of a surface in the specified units.

Syntax

surface-expression.**ST_Perimeter**([*unit-name*])

Parameters

Name	Type	Description
unit-name	VAR-CHAR(128)	The units in which the length should be computed. Defaults to the unit of the spatial reference system. The unit name must match the UNIT_NAME column of a row in the ST_UNITS_OF_MEASURE view where UNIT_TYPE is 'LINEAR'.

Returns

- **DOUBLE** Returns the perimeter of the surface in the specified unit of measure.

Remarks

The ST_Perimeter method returns the length of the perimeter of a surface in the units identified by the *unit-name* parameter. If the surface is empty, then NULL is returned.

If the surface contains Z values, these are not considered when computing the perimeter of the geometry.

The perimeter of a polygon includes the length of all rings (exterior and interior).

Note
If the *surface-expression* is an empty geometry (ST_IsEmpty()=1), then this method returns NULL.

Note
By default, ST_Perimeter uses the original format for a geometry, if it is available. Otherwise, the internal format is used. For more information about internal and original formats, see "STORAGE FORMAT clause, CREATE SPATIAL REFERENCE SYSTEM statement" [*SQL Anywhere Server - SQL Reference*].

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1.3

Example

The following example creates a multicurve and an example unit of measure (example_unit_halfmetre). The ST_Length method finds the length of the geometry in this unit of measure, returning the value 6.0.

```
CREATE SPATIAL UNIT OF MEASURE IF NOT EXISTS  "example_unit_halfmetre" TYPE
LINEAR CONVERT USING .5;
SELECT NEW ST_MultiCurve(
        NEW ST_LineString('LineString (0 0, 1 0)' ),
        NEW ST_LineString('LineString (0 2, 2 2)' ) )
        .ST_Length('example_unit_halfmetre');
```

ST_PointOnSurface method for type ST_Surface

Returns an ST_Point value that is guaranteed to spatially intersect the ST_Surface value.

Note
If the *surface-expression* contains circular strings, then these are interpolated to line strings.

Syntax

surface-expression.**ST_PointOnSurface**()

Returns

- **ST_Point** If the surface is the empty set, returns NULL. Otherwise, returns an ST_Point value guaranteed to spatially intersect the ST_Surface value.

  The spatial reference system identifier of the result is the same as the spatial reference system of the *surface-expression*.

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.1.5

Spatial compatibility functions

The SQL/MM standard defines a number of functions that can be used to perform spatial operations. In most cases, these functions duplicate functionality of methods or constructors of spatial data types.

Functions

Name	Description
"ST_BdMPolyFromText function [Spatial]" on page 295	Returns an ST_MultiPolygon value built from the WKT representation of a multilinestring.
"ST_BdMPolyFromWKB function [Spatial]" on page 296	Returns an ST_MultiPolygon value built from the WKB representation of a multilinestring.
"ST_BdPolyFromText function [Spatial]" on page 297	Returns an ST_Polygon value built from the WKT representation of a multilinestring.
"ST_BdPolyFromWKB function [Spatial]" on page 298	Returns an ST_Polygon value built from the WKB representation of a multilinestring.
"ST_CPolyFromText function [Spatial]" on page 298	Returns an ST_CurvePolygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CurvePolygon
"ST_CPolyFromWKB function [Spatial]" on page 299	Returns an ST_CurvePolygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CurvePolygon

Name	Description
"ST_CircularFromTxt function [Spatial]" on page 300	Returns an ST_CircularString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CircularString
"ST_CircularFromWKB function [Spatial]" on page 301	Returns an ST_CircularString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CircularString
"ST_CompoundFromTxt function [Spatial]" on page 302	Returns an ST_CompoundCurve value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CompoundCurve
"ST_CompoundFromWKB function [Spatial]" on page 303	Returns an ST_CompoundCurve value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CompoundCurve
"ST_GeomCollFromTxt function [Spatial]" on page 304	Returns an ST_GeomCollection value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_GeomCollection
"ST_GeomCollFromWKB function [Spatial]" on page 305	Returns an ST_GeomCollection value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_GeomCollection
"ST_GeomFromText function [Spatial]" on page 306	Returns an ST_Geometry value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Geometry
"ST_GeomFromWKB function [Spatial]" on page 307	Returns an ST_Geometry value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Geometry
"ST_LineFromText function [Spatial]" on page 308	Returns an ST_LineString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_LineString
"ST_LineFromWKB function [Spatial]" on page 309	Returns an ST_LineString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_LineString
"ST_MCurveFromText function [Spatial]" on page 310	Returns an ST_MultiCurve value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiCurve

Name	Description
"ST_MCurveFromWKB function [Spatial]" on page 311	Returns an ST_MultiCurve value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiCurve
"ST_MLineFromText function [Spatial]" on page 312	Returns an ST_MultiLineString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiLineString
"ST_MLineFromWKB function [Spatial]" on page 313	Returns an ST_MultiLineString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiLineString
"ST_MPointFromText function [Spatial]" on page 314	Returns an ST_MultiPoint value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiPoint
"ST_MPointFromWKB function [Spatial]" on page 315	Returns an ST_MultiPoint value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiPoint
"ST_MPolyFromText function [Spatial]" on page 316	Returns an ST_MultiPolygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiPolygon
"ST_MPolyFromWKB function [Spatial]" on page 317	Returns an ST_MultiPolygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiPolygon
"ST_MSurfaceFromTxt function [Spatial]" on page 318	Returns an ST_MultiSurface value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiSurface
"ST_MSurfaceFromWKB function [Spatial]" on page 319	Returns an ST_MultiSurface value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiSurface
"ST_OrderingEquals function [Spatial]" on page 320	Tests if a geometry is identical to another geometry.
"ST_PointFromText function [Spatial]" on page 321	Returns an ST_Point value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Point
"ST_PointFromWKB function [Spatial]" on page 322	Returns an ST_Point value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Point

Name	Description
"ST_PolyFromText function [Spatial]" on page 323	Returns an ST_Polygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Polygon
"ST_PolyFromWKB function [Spatial]" on page 324	Returns an ST_Polygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Polygon

ST_BdMPolyFromText function [Spatial]

Returns an ST_MultiPolygon value built from the WKT representation of a multilinestring.

Syntax

[**DBO**.]**ST_BdMPolyFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation of a multilinestring value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPolygon** Returns an ST_MultiPolygon value built from the WKT representation of a multilinestring.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Note
The ST_BdMPolyFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_BdMPolyFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_BdMPolyFromText( awkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_MultiPolygon
BEGIN
    DECLARE mls ST_MultiLineString;
    SET mls = NEW ST_MultiLineString( awkt, srid );
    RETURN NEW ST_MultiPolygon( mls );
END
```

See also

- “ST_Polygon constructor” on page 274

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.7

ST_BdMPolyFromWKB function [Spatial]

Returns an ST_MultiPolygon value built from the WKB representation of a multilinestring.

Syntax

[**DBO.**]**ST_BdMPolyFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation of a multilinestring value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPolygon** Returns an ST_MultiPolygon value built from the WKB representation of a multilinestring.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_BdMPolyFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See “sa_install_feature system procedure” [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_BdMPolyFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_BdMPolyFromWKB( awkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiPolygon
BEGIN
    DECLARE mls ST_MultiLineString;
    SET mls = NEW ST_MultiLineString( awkb, srid );
    RETURN NEW ST_MultiPolygon( mls );
END
```

See also

- “ST_Polygon constructor” on page 274

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.8

ST_BdPolyFromText function [Spatial]

Returns an ST_Polygon value built from the WKT representation of a multilinestring.

Syntax

[**DBO**.]**ST_BdPolyFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation of a multilinestring value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Polygon** Returns an ST_Polygon value built from the WKT representation of a multilinestring.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_BdPolyFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_BdPolyFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_BdPolyFromText( awkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_Polygon
BEGIN
    DECLARE mls ST_MultiLineString;
    SET mls = NEW ST_MultiLineString( awkt, srid );
    RETURN NEW ST_Polygon( mls );
END
```

See also

- "ST_Polygon constructor" on page 274

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.9

ST_BdPolyFromWKB function [Spatial]

Returns an ST_Polygon value built from the WKB representation of a multilinestring.

Syntax

[**DBO.**]**ST_BdPolyFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation of a multilinestring value.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Polygon** Returns an ST_Polygon value built from the WKB representation of a multilinestring.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_BdPolyFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_BdPolyFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_BdPolyFromWKB( awkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_Polygon
BEGIN
    DECLARE mls ST_MultiLineString;
    SET mls = NEW ST_MultiLineString( awkb, srid );
    RETURN NEW ST_Polygon( mls );
END
```

See also

- "ST_Polygon constructor" on page 274

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.10

ST_CPolyFromText function [Spatial]

Returns an ST_CurvePolygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CurvePolygon

Syntax

[**DBO.**]**ST_CPolyFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CurvePolygon** Returns an ST_CurvePolygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_CPolyFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CPolyFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CPolyFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_CurvePolygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_CurvePolygon);
END
```

See also

- "ST_CurvePolygon constructor" on page 74
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.8

ST_CPolyFromWKB function [Spatial]

Returns an ST_CurvePolygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CurvePolygon

Syntax

[**DBO.**]**ST_CPolyFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CurvePolygon** Returns an ST_CurvePolygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_CPolyFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CPolyFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CPolyFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_CurvePolygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_CurvePolygon);
END
```

See also

- "ST_CurvePolygon constructor" on page 74
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.2.9

ST_CircularFromTxt function [Spatial]

Returns an ST_CircularString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CircularString

Syntax

[DBO.]ST_CircularFromTxt(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CircularString** Returns an ST_CircularString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_CircularFromTxt function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CircularFromTxt function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CircularFromTxt( wkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_CircularString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_CircularString);
END
```

See also

- "ST_CircularString constructor" on page 60
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.9

ST_CircularFromWKB function [Spatial]

Returns an ST_CircularString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CircularString

Syntax

[**DBO.**]**ST_CircularFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CircularString** Returns an ST_CircularString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_CircularFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CircularFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CircularFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_CircularString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_CircularString);
END
```

See also

- "ST_CircularString constructor" on page 60
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.3.10

ST_CompoundFromTxt function [Spatial]

Returns an ST_CompoundCurve value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_CompoundCurve

Syntax

[DBO.]ST_CompoundFromTxt(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CompoundCurve** Returns an ST_CompoundCurve value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Note
The ST_CompoundFromTxt function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CompoundFromTxt function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CompoundFromTxt( wkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_CompoundCurve
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_CompoundCurve);
END
```

See also

- "ST_CompoundCurve constructor" on page 65
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.8

ST_CompoundFromWKB function [Spatial]

Returns an ST_CompoundCurve value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_CompoundCurve

Syntax

[**DBO**.]**ST_CompoundFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_CompoundCurve** Returns an ST_CompoundCurve value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_CompoundFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_CompoundFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_CompoundFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_CompoundCurve
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_CompoundCurve);
END
```

See also

- "ST_CompoundCurve constructor" on page 65
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.4.9

ST_GeomCollFromTxt function [Spatial]

Returns an ST_GeomCollection value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_GeomCollection

Syntax

[DBO.]ST_GeomCollFromTxt(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_GeomCollection** Returns an ST_GeomCollection value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_GeomCollFromTxt function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_GeomCollFromTxt function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_GeomCollFromTxt( wkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_GeomCollection
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_GeomCollection);
END
```

See also

- "ST_GeomCollection constructor" on page 83
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.6

ST_GeomCollFromWKB function [Spatial]

Returns an ST_GeomCollection value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_GeomCollection

Syntax

[**DBO**.]**ST_GeomCollFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_GeomCollection** Returns an ST_GeomCollection value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_GeomCollFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_GeomCollFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_GeomCollFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_GeomCollection
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_GeomCollection);
END
```

See also

- "ST_GeomCollection constructor" on page 83
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.1.7

ST_GeomFromText function [Spatial]

Returns an ST_Geometry value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Geometry

Syntax

[DBO.]ST_GeomFromText(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns an ST_Geometry value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_GeomFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_GeomFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_GeomFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_Geometry
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_Geometry);
END
```

See also

- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.40

ST_GeomFromWKB function [Spatial]

Returns an ST_Geometry value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Geometry

Syntax

[**DBO**.]**ST_GeomFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Geometry** Returns an ST_Geometry value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_GeomFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_GeomFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_GeomFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_Geometry
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_Geometry);
END
```

See also

- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.41

ST_LineFromText function [Spatial]

Returns an ST_LineString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_LineString

Syntax

[**DBO**.]**ST_LineFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_LineString** Returns an ST_LineString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_LineFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_LineFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_LineFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_LineString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_LineString);
END
```

See also

- "ST_LineString constructor" on page 224
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.8

ST_LineFromWKB function [Spatial]

Returns an ST_LineString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_LineString

Syntax

[**DBO**.]**ST_LineFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_LineString** Returns an ST_LineString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_LineFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_LineFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_LineFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_LineString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_LineString);
END
```

See also

- "ST_LineString constructor" on page 224
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 7.2.9

ST_MCurveFromText function [Spatial]

Returns an ST_MultiCurve value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiCurve

Syntax

[DBO.]ST_MCurveFromText(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiCurve** Returns an ST_MultiCurve value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MCurveFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MCurveFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MCurveFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_MultiCurve
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_MultiCurve);
END
```

See also

- "ST_MultiCurve constructor" on page 229
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.6

ST_MCurveFromWKB function [Spatial]

Returns an ST_MultiCurve value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiCurve

Syntax

[**DBO.**]**ST_MCurveFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiCurve** Returns an ST_MultiCurve value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MCurveFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MCurveFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MCurveFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiCurve
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_MultiCurve);
END
```

See also

- "ST_MultiCurve constructor" on page 229
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.3.7

ST_MLineFromText function [Spatial]

Returns an ST_MultiLineString value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiLineString

Syntax

[DBO.]ST_MLineFromText(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiLineString** Returns an ST_MultiLineString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Note
The ST_MLineFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MLineFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MLineFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_MultiLineString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_MultiLineString);
END
```

See also

- "ST_MultiLineString constructor" on page 236
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.4.4

ST_MLineFromWKB function [Spatial]

Returns an ST_MultiLineString value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiLineString

Syntax

[**DBO**.]**ST_MLineFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiLineString** Returns an ST_MultiLineString value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MLineFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MLineFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MLineFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiLineString
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_MultiLineString);
END
```

See also

- "ST_MultiLineString constructor" on page 236
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.4.5

ST_MPointFromText function [Spatial]

Returns an ST_MultiPoint value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiPoint

Syntax

[DBO.]ST_MPointFromText(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPoint** Returns an ST_MultiPoint value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MPointFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MPointFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MPointFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_MultiPoint
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_MultiPoint);
END
```

See also

- "ST_MultiPoint constructor" on page 240
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.2.4

ST_MPointFromWKB function [Spatial]

Returns an ST_MultiPoint value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiPoint

Syntax

[**DBO**.]**ST_MPointFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPoint** Returns an ST_MultiPoint value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MPointFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MPointFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MPointFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiPoint
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_MultiPoint);
END
```

See also

- "ST_MultiPoint constructor" on page 240
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.2.5

ST_MPolyFromText function [Spatial]

Returns an ST_MultiPolygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiPolygon

Syntax

[DBO.]ST_MPolyFromText(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPolygon** Returns an ST_MultiPolygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MPolyFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MPolyFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MPolyFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_MultiPolygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_MultiPolygon);
END
```

See also

- "ST_MultiPolygon constructor" on page 245
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.4

ST_MPolyFromWKB function [Spatial]

Returns an ST_MultiPolygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiPolygon

Syntax

[**DBO.**]**ST_MPolyFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiPolygon** Returns an ST_MultiPolygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MPolyFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MPolyFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MPolyFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiPolygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_MultiPolygon);
END
```

See also

- "ST_MultiPolygon constructor" on page 245
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.6.5

ST_MSurfaceFromTxt function [Spatial]

Returns an ST_MultiSurface value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_MultiSurface

Syntax

[DBO.]ST_MSurfaceFromTxt(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiSurface** Returns an ST_MultiSurface value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MSurfaceFromTxt function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MSurfaceFromTxt function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MSurfaceFromTxt( wkt LONG VARCHAR, srid INT DEFAULT
0 )
RETURNS ST_MultiSurface
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_MultiSurface);
END
```

See also

- "ST_MultiSurface constructor" on page 251
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.8

ST_MSurfaceFromWKB function [Spatial]

Returns an ST_MultiSurface value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_MultiSurface

Syntax

[**DBO**.]**ST_MSurfaceFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_MultiSurface** Returns an ST_MultiSurface value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_MSurfaceFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_MSurfaceFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_MSurfaceFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_MultiSurface
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_MultiSurface);
END
```

See also

- "ST_MultiSurface constructor" on page 251
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 9.5.9

ST_OrderingEquals function [Spatial]

Tests if a geometry is identical to another geometry.

Syntax

[DBO.]ST_OrderingEquals(*geo1*,*geo2*)

Parameters

Name	Type	Description
geo1	ST_Geometry	The first geometry value that is to be ordered.
geo2	ST_Geometry	The second geometry value that is to be ordered.

Returns

- **INT** Returns 1 if *geo1* is exactly equal to *geo2*, otherwise 0.

> **Note**
> The ST_OrderingEquals function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_OrderingEquals function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_OrderingEquals( geo1 ST_Geometry, geo2 ST_Geometry )
RETURNS INT
BEGIN
    RETURN geo1.ST_OrderingEquals( geo2 );
END
```

See also

- "ST_OrderingEquals method for type ST_Geometry" on page 178

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 5.1.43

ST_PointFromText function [Spatial]

Returns an ST_Point value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Point

Syntax

[**DBO.**]**ST_PointFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Point** Returns an ST_Point value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_PointFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_PointFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_PointFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_Point
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_Point);
END
```

See also

- "ST_Point constructor" on page 259
- "ST_GeomFromText method for type ST_Geometry" on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.8

ST_PointFromWKB function [Spatial]

Returns an ST_Point value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Point

Syntax

[**DBO.**]**ST_PointFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Point** Returns an ST_Point value created from the input string.

The spatial reference system identifier of the result is the given by parameter *srid*.

> **Note**
> The ST_PointFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_PointFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_PointFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_Point
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_Point);
END
```

See also

- "ST_Point constructor" on page 259
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 6.1.9

ST_PolyFromText function [Spatial]

Returns an ST_Polygon value, which is transformed from a LONG VARCHAR value containing the WKT representation of an ST_Polygon

Syntax

[**DBO**.]**ST_PolyFromText**(*wkt*[, *srid*])

Parameters

Name	Type	Description
wkt	LONG VARCHAR	The WKT representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Polygon** Returns an ST_Polygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Note
The ST_PolyFromText function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See “sa_install_feature system procedure” [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_PolyFromText function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_PolyFromText( wkt LONG VARCHAR, srid INT DEFAULT 0 )
RETURNS ST_Polygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromText( wkt, srid );
    RETURN CAST( geo AS ST_Polygon);
END
```

See also

- “ST_Polygon constructor” on page 274
- “ST_GeomFromText method for type ST_Geometry” on page 158

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.6

ST_PolyFromWKB function [Spatial]

Returns an ST_Polygon value, which is transformed from a LONG BINARY value containing the WKB representation of an ST_Polygon

Syntax

[**DBO**.]**ST_PolyFromWKB**(*wkb*[, *srid*])

Parameters

Name	Type	Description
wkb	LONG BINARY	The WKB representation.
srid	INT	The SRID of the result. If not specified, the default is 0.

Returns

- **ST_Polygon** Returns an ST_Polygon value created from the input string.

  The spatial reference system identifier of the result is the given by parameter *srid*.

Note
The ST_PolyFromWKB function is not present by default in newly created databases. Use the sa_install_feature system procedure to install the spatial SQL compatibility functions. See "sa_install_feature system procedure" [*SQL Anywhere Server - SQL Reference*].

Remarks

The ST_PolyFromWKB function is equivalent to the following:

```
CREATE FUNCTION DBO.ST_PolyFromWKB( wkb LONG BINARY, srid INT DEFAULT 0 )
RETURNS ST_Polygon
BEGIN
    DECLARE geo ST_Geometry;

    set geo = ST_Geometry::ST_GeomFromWKB( wkb, srid );
    RETURN CAST( geo AS ST_Polygon);
END
```

See also

- "ST_Polygon constructor" on page 274
- "ST_GeomFromWKB method for type ST_Geometry" on page 159

Standards and compatibility

- **SQL/MM (ISO/IEC 13249-3: 2006)** 8.3.7

List of all supported methods

The following is a list of all supported spatial methods:

List of all supported constructors

The following is a list of all supported spatial constructors:

List of static methods

The following is a list of static methods available for use with spatial data:

- “ST_AsSVGAggr method for type ST_Geometry” on page 107
- “ST_CompareWKT method for type ST_SpatialRefSys” on page 281
- “ST_ConvexHullAggr method for type ST_Geometry” on page 139
- “ST_EnvelopeAggr method for type ST_Geometry” on page 154
- “ST_FormatTransformDefinition method for type ST_SpatialRefSys” on page 282
- “ST_FormatWKT method for type ST_SpatialRefSys” on page 283
- “ST_GeomCollectionAggr method for type ST_GeomCollection” on page 86
- “ST_GeomFromBinary method for type ST_Geometry” on page 157
- “ST_GeomFromShape method for type ST_Geometry” on page 158
- “ST_GeomFromText method for type ST_Geometry” on page 158
- “ST_GeomFromWKB method for type ST_Geometry” on page 159
- “ST_GeomFromWKT method for type ST_Geometry” on page 160
- “ST_GeometryTypeFromBaseType method for type ST_Geometry” on page 162
- “ST_GetUnProjectedTransformDefinition method for type ST_SpatialRefSys” on page 284
- “ST_IntersectionAggr method for type ST_Geometry” on page 164
- “ST_LineStringAggr method for type ST_LineString” on page 227
- “ST_LinearUnHash method for type ST_Geometry” on page 173
- “ST_LoadConfigurationData method for type ST_Geometry” on page 174
- “ST_MultiCurveAggr method for type ST_MultiCurve” on page 234
- “ST_MultiLineStringAggr method for type ST_MultiLineString” on page 239
- “ST_MultiPointAggr method for type ST_MultiPoint” on page 243
- “ST_MultiPolygonAggr method for type ST_MultiPolygon” on page 249
- “ST_MultiSurfaceAggr method for type ST_MultiSurface” on page 256
- “ST_ParseWKT method for type ST_SpatialRefSys” on page 285
- “ST_SRIDFromBaseType method for type ST_Geometry” on page 187
- “ST_TransformGeom method for type ST_SpatialRefSys” on page 286
- “ST_UnionAggr method for type ST_Geometry” on page 210
- “ST_World method for type ST_SpatialRefSys” on page 287

List of aggregate methods

The following is a list of aggregate methods available for use with spatial data:

- “ST_AsSVGAggr method for type ST_Geometry” on page 107
- “ST_ConvexHullAggr method for type ST_Geometry” on page 139
- “ST_EnvelopeAggr method for type ST_Geometry” on page 154
- “ST_GeomCollectionAggr method for type ST_GeomCollection” on page 86
- “ST_IntersectionAggr method for type ST_Geometry” on page 164
- “ST_LineStringAggr method for type ST_LineString” on page 227
- “ST_MultiCurveAggr method for type ST_MultiCurve” on page 234
- “ST_MultiLineStringAggr method for type ST_MultiLineString” on page 239
- “ST_MultiPointAggr method for type ST_MultiPoint” on page 243
- “ST_MultiPolygonAggr method for type ST_MultiPolygon” on page 249
- “ST_MultiSurfaceAggr method for type ST_MultiSurface” on page 256
- “ST_UnionAggr method for type ST_Geometry” on page 210

List of set operation methods

The following is a list of set operation methods available for use with spatial data:

- “ST_Difference method for type ST_Geometry” on page 147
- “ST_Intersection method for type ST_Geometry” on page 163
- “ST_IntersectionAggr method for type ST_Geometry” on page 164
- “ST_SymDifference method for type ST_Geometry” on page 190
- “ST_Union method for type ST_Geometry” on page 209
- “ST_UnionAggr method for type ST_Geometry” on page 210

List of spatial predicates

The following is a list of predicate methods available for use with spatial data:

- "ST_Contains method for type ST_Geometry" on page 135
- "ST_ContainsFilter method for type ST_Geometry" on page 137
- "ST_CoveredBy method for type ST_Geometry" on page 142
- "ST_CoveredByFilter method for type ST_Geometry" on page 143
- "ST_Covers method for type ST_Geometry" on page 144
- "ST_CoversFilter method for type ST_Geometry" on page 145
- "ST_Crosses method for type ST_Geometry" on page 146
- "ST_Disjoint method for type ST_Geometry" on page 150
- "ST_Equals method for type ST_Geometry" on page 154
- "ST_EqualsFilter method for type ST_Geometry" on page 156
- "ST_Intersects method for type ST_Geometry" on page 165
- "ST_IntersectsFilter method for type ST_Geometry" on page 166
- "ST_IntersectsRect method for type ST_Geometry" on page 167
- "ST_OrderingEquals method for type ST_Geometry" on page 178
- "ST_Overlaps method for type ST_Geometry" on page 180
- "ST_Relate method for type ST_Geometry" on page 181
- "ST_Touches method for type ST_Geometry" on page 207
- "ST_Within method for type ST_Geometry" on page 211
- "ST_WithinDistance method for type ST_Geometry" on page 212
- "ST_WithinDistanceFilter method for type ST_Geometry" on page 214
- "ST_WithinFilter method for type ST_Geometry" on page 216

Index

Symbols

A

B

C

D

E

F

G

H

I

J

T

U

W