

# Oracle® Database

## Introduction to Simple Oracle Document Access (SODA)



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# Contents

## Preface

---

Audience	viii
Documentation Accessibility	viii
Related Documents	viii
Conventions	ix

## Changes in SODA

---

Changes in Oracle Database Release 18c for SODA	x
Changes in Oracle Database Release 12c (12.2.0.1) for SODA	x

## 1 Overview of SODA

---

1.1 Overview of SODA Documents	1-3
1.2 Overview of SODA Document Collections	1-5
1.3 Default Naming of a Collection Table	1-9

## 2 Overview of SODA Filter Specifications (QBEs)

---

2.1 Sample JSON Documents	2-3
2.2 Overview of Paths in SODA QBEs	2-4
2.3 Overview of QBE Comparison Operators	2-5
2.4 Overview of QBE Operator \$not	2-7
2.5 Overview of QBE Item-Method Operators	2-7
2.6 Overview of QBE Logical Combining Operators	2-9
2.7 Overview of Nested Conditions in QBEs	2-11
2.8 Overview of QBE Operator \$id	2-12
2.9 Overview of QBE Operator \$orderby	2-12
2.10 Overview of QBE Spatial Operators	2-14

## 3 Overview of SODA Indexing

---

4	SODA Paths (Reference)	
<hr/>		
5	SODA Filter Specifications (Reference)	
<hr/>		
5.1	Composite Filters (Reference)	5-2
5.1.1	Orderby Clause Sorts Selected Objects	5-3
5.2	Filter Conditions (Reference)	5-6
5.2.1	Scalar-Equality Clause (Reference)	5-7
5.2.2	Field-Condition Clause (Reference)	5-8
5.2.2.1	Comparison Clause (Reference)	5-9
5.2.2.2	Not Clause (Reference)	5-13
5.2.2.3	Item-Method Clause (Reference)	5-14
5.2.2.4	ISO 8601 Date and Time Support	5-20
5.2.3	Logical Combining Clause (Reference)	5-21
5.2.3.1	Omitting \$and	5-22
5.2.4	Nested-Condition Clause (Reference)	5-23
5.2.5	ID Clause (Reference)	5-24
5.2.6	Special-Criterion Clause (Reference)	5-25
5.2.6.1	Contains Clause (Reference)	5-25
5.2.6.2	Spatial Clause (Reference)	5-27
6	SODA Index Specifications (Reference)	
<hr/>		
7	SODA Collection Metadata Components (Reference)	
<hr/>		
7.1	Schema	7-3
7.2	Table or View	7-3
7.3	Key Column Name	7-4
7.4	Key Column Type	7-4
7.5	Key Column Max Length	7-5
7.6	Key Column Assignment Method	7-5
7.7	Key Column Sequence Name	7-6
7.8	Content Column Name	7-7
7.9	Content Column Type	7-7
7.10	Content Column Max Length	7-7
7.11	Content Column JSON Validation	7-8
7.12	Content Column SecureFiles LOB Compression	7-9
7.13	Content Column SecureFiles LOB Cache	7-9
7.14	Content Column SecureFiles LOB Encryption	7-9
7.15	Version Column Name	7-10

7.16	Version Column Generation Method	7-10
7.17	Last-Modified Time Stamp Column Name	7-11
7.18	Last-Modified Column Index Name	7-12
7.19	Creation Time Stamp Column Name	7-13
7.20	Media Type Column Name	7-13
7.21	Read Only	7-13

## 8 SODA Guidelines and Restrictions

---

8.1	SODA Guidelines	8-1
8.2	SODA Restrictions (Reference)	8-2

## Index

---

## List of Examples

---

1-1	Default Collection Metadata	1-8
2-1	Sample JSON Document 1	2-3
2-2	Sample JSON Document 2	2-3
2-3	Sample JSON Document 3	2-3
2-4	Using \$id To Find Documents That Have Given Keys	2-12
3-1	Specifying a B-Tree Index	3-2
3-2	Specifying a Spatial Index	3-2
3-3	Specifying a JSON Search Index	3-4
5-1	Filter Specification with Explicit \$and Operator	5-22
5-2	Filter Specification with Implicit \$and Operator	5-23
5-3	Use of Operator \$id in the Outermost QBE Condition	5-24
5-4	QBE With a Spatial Clause	5-27

## List of Tables

---

5-1	Query-By-Example (QBE) Comparison Operators	5-9
5-2	Item-Method Operators	5-16
7-1	Key Assignment Methods	7-5
7-2	Version Generation Methods	7-11

# Preface

This document provides a conceptual overview of Simple Oracle Document Access (SODA).

- [Audience](#)
- [Documentation Accessibility](#)
- [Related Documents](#)
- [Conventions](#)

## Audience

This document is intended for users of Simple Oracle Document Access (SODA).

## Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at <http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc>.

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## Related Documents

For more information, see these Oracle resources:

- [Simple Oracle Document Access \(SODA\)](#) at Oracle Help Center for complete information about SODA and each of its implementations
- *Oracle Database JSON Developer's Guide*
- *Oracle as a Document Store* for general information about using JSON data in Oracle Database, including with SODA

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## Conventions

The following text conventions are used in this document:

Convention	Meaning
<b>boldface</b>	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
<i>italic</i>	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
monospace	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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# Changes in SODA

- [Changes in Oracle Database Release 18c for SODA](#)
- [Changes in Oracle Database Release 12c \(12.2.0.1\) for SODA](#)

## Changes in Oracle Database Release 18c for SODA

- [New Features for Oracle Database Release 18c](#)  
New features for Oracle Database Release 18c include new QBE item methods, new data types for QBE operator `$orderby`, and B-tree indexing with additional data types.

### New Features for Oracle Database Release 18c

New features for Oracle Database Release 18c include new QBE item methods, new data types for QBE operator `$orderby`, and B-tree indexing with additional data types.

**Note:**

Supported features can vary among SODA implementations. The new features listed here are not necessarily supported by all implementations.

- New item methods: `$abs`, `$date`, `$size`, `$timestamp`, and `$type`.
- Use of data types `date` and `timestamp` with QBE operator `$orderby`.
- B-tree indexing with `date` and `timestamp` data types.

## Changes in Oracle Database Release 12c (12.2.0.1) for SODA

- [New Features for Oracle Database Release 12c \(12.2.0.1\)](#)  
New features for Oracle Database Release 12c (12.2.0.1) include QBE item methods, support for indexing, and support for proximity and full-text searching of JSON documents.

### New Features for Oracle Database Release 12c (12.2.0.1)

New features for Oracle Database Release 12c (12.2.0.1) include QBE item methods, support for indexing, and support for proximity and full-text searching of JSON documents.

 **Note:**

Supported features can vary among SODA implementations. The new features listed here are not necessarily supported by all implementations.

- Item methods for QBE — Use QBE item methods (`$boolean`, `$ceiling`, `$double`, `$floor`, `$length`, `$lower`, `$number`, `$string`, `$upper`) to transform matched data before filtering it further.
- GeoJSON proximity search — Use query-by-example (QBE) to select documents that have a field whose value is a GeoJSON `geometry` object that is *near* a specified position, *intersects* a specified geometric object, or is *within* another specified geometric object.
- Full-text search — Use QBE to select documents with fields whose value matches a given string or number.
- Indexing — Index documents in a collection: B-tree, GeoJSON geometry (spatial), and JSON search.

# 1

## Overview of SODA

**Simple Oracle Document Access (SODA)** is a set of NoSQL-style APIs that let you create and store collections of documents (in particular JSON) in Oracle Database, retrieve them, and query them, without needing to know Structured Query Language (SQL) or how the documents are stored in the database.

There are separate SODA implementations for use with different languages and with the representational state transfer (**REST**) architectural style. SODA for REST can itself be accessed from almost any programming language. It maps SODA operations to Uniform Resource Locator (**URL**) patterns.

### Note:

This book describes the features that are present in different SODA implementations. Some features described here may not be available for some implementations. In addition, different implementations can have different ways of providing some of the features. Please refer to the documentation for a particular implementation for detailed information about it.

SODA APIs are *document-centric*. You can use any SODA implementation to perform create, read, update, and delete (**CRUD**) operations on documents of nearly any kind (including video, image, sound, and other binary content). You can also use any SODA implementation to query the content of JavaScript Object Notation (**JSON**) documents using pattern-matching: query-by-example (QBE). CRUD operations can be driven by document keys or by QBEs.

Oracle Database supports storing and querying JSON data natively. SODA document collections are backed by ordinary database tables and views. Because of this, you can take advantage of database features for use with the content of SODA documents.

But you do *not* need knowledge of SQL, or database administrator (DBA) assistance, to develop or deploy a SODA application. SODA CRUD and query operations are automatically mapped to SQL operations on the underlying database tables or views, and these operations are optimized.

The SQL standard defines a set of SQL/JSON operators that allow direct querying of JSON data. Database *views* based on these operators provide schema-on-read behavior that is immune to changes in the structure of your documents. If needed, developers with SQL knowledge can use SQL/JSON to perform advanced operations on your SODA data that make full use of the database. For example, a SQL developer can apply database analytics and reporting to your JSON data, and can include it in aggregation and join operations that involve other data. In addition, your SODA applications can use database *transactions*.

These SODA abstractions hide the complexities of SQL and client programming:

- Collection
- Document

A document **collection** contains **documents**. Collections are persisted in an Oracle Database **schema** (also known as a database **user**). In some SODA implementations a database schema is referred to as a SODA **database**.

A SODA *collection* is analogous to an Oracle Database *table* or *view*.

SODA is designed primarily for working with JSON documents, but a document can be of any Multipurpose Internet Mail Extensions (MIME) type.

In addition to its content, a document has other **document components**, including a unique identifier, called its **key**, a version, a media type (type of content), and the date and time that it was created and last modified. The key is typically assigned by SODA when a document is created, but client-assigned keys can also be used. Besides the content and key (if client-assigned), you can set the media type of a document. The other components are generated and maintained by SODA. All components other than content and key are optional.

A SODA *document* is analogous to, and is in fact backed by, a *row* of a database table or view. The row has one *column* for each document component: key, content, version, and so on.

In addition to the documents it contains, a collection also has associated **collection metadata**. This specifies various details about the collection, such as its storage, whether it should track version and time-stamp document components, how such components are generated, and whether the collection can contain only JSON documents.

In some contexts collection metadata is represented as a JSON document. This metadata document is sometimes called a **collection specification**. You can supply a custom collection specification when you create a collection, to provide metadata that differs from that provided by default.

SODA provides CRUD operations on documents. JSON documents can additionally be queried, using **query-by-example (QBE)** patterns, also known as **filter specifications**. A filter specification is itself a JSON object.

SODA APIs provide operations for collection management (create, drop, list) and document management (CRUD).

These are some of the actions you can perform using SODA:

- Create collections
- Open existing collections
- Drop collections
- List all existing collections
- Create documents
- Insert documents into a collection
- Find a document in a collection, by key or by key and version
- Find all documents in a collection
- Find documents in a collection, by keys or by QBE

- Replace (update) a document in a collection, by key or by key and version (optimistic locking)
- Remove a document from a collection, by key or by key and version (optimistic locking)
- Remove documents from a collection, by keys or by QBE
- Index the documents in a collection (to improve query performance)
- Create a JSON data guide for a collection, which summarizes document structural and type information

Your applications use a database transaction when performing one or more such actions.<sup>1</sup>

- [Overview of SODA Documents](#)  
SODA is designed primarily to manipulate JavaScript Object Notation (JSON) documents, that is, documents whose content is JSON data, but other kinds of documents can also be used. A document has other components, besides its content.
- [Overview of SODA Document Collections](#)  
A SODA collection is a set of documents that is backed by an Oracle Database table or view.
- [Default Naming of a Collection Table](#)  
By default, the name of the database table that underlies a document collection is derived from the collection name.

#### See Also:

- [Simple Oracle Document Access \(SODA\)](#) at Oracle Help Center for complete information about SODA and each of its implementations
- *Oracle Database JSON Developer's Guide* for information about using SQL and PL/SQL with JSON data.
- [Introducing JSON](#) for information about JSON.
- *Oracle as a Document Store* for general information about using JSON data in Oracle Database, including with SODA

## 1.1 Overview of SODA Documents

SODA is designed primarily to manipulate JavaScript Object Notation (JSON) documents, that is, documents whose content is JSON data, but other kinds of documents can also be used. A document has other components, besides its content.

Here is a textual representation of the content of a simple JSON document:

```
{ "name"      : "Alexander",  
  "address"  : "1234 Main Street",  
  "city"     : "Anytown",
```

<sup>1</sup> SODA for REST is an exception in this regard; you cannot use database transactions for its actions.

```
"state" : "CA",  
"zip"   : "12345" }
```

You can set the following document components (with an application client, for example):

- Key
- Content
- Media type

In a collection, each document must have a document key, which is unique for the collection. By default, collections are configured to automatically generate document keys for inserted documents. If you want to instead use your own, custom, keys for a collection then you must provide the key for a document when you create it.

The media type specifies the type of content for a document. For JSON documents the media type is "application/json".

The following document components are set and maintained automatically by SODA itself:

- Version
- Creation time stamp
- Last-modified time stamp

A SODA document is an *abstract object* that encapsulates its components, including its content — it is a carrier of content. A SODA create-document operation creates such a programmatic document object, and a document object is returned by some SODA operations, such as find operations.

A document is stored in Oracle Database as a row in a table or view, with each component in its own column.

In a client application, a SODA document is represented in a way that is appropriate to the particular SODA implementation used. For example:

- In SODA for Java, a document is represented as a Java interface.
- In SODA for PL/SQL, a document is represented as a PL/SQL object type.
- In SODA for C, a document is represented as an Oracle Call Interface (OCI) handle.

In all cases, there are methods or functions to create documents and access their components.

To write content to SODA collections and read content from them, you use create-document, write, and read operations:

- You use a SODA *create-document* operation to create a document object with content that you provide. (The content can be JSON data or something else.)

---

<sup>2</sup> Because REST is not a programming language, SODA for REST has no programmatic "object" that represents a document. But SODA for REST operations involve the same concept of a document. For example, when you read a document you obtain a JSON representation of it, which includes all of the components (key, content, version, and so on).

- You use a SODA *write* operation (such as insert), to store the document persistently in Oracle Database. (The document content is written to a database table.)
- You use a SODA *read* operation (such as find), to fetch the document back from Oracle Database. You use specific *getter* operations to read specific document components (such as key and content).

**See Also:**

Introducing JSON for general information about JSON

## 1.2 Overview of SODA Document Collections

A SODA collection is a set of documents that is backed by an Oracle Database table or view.

*By default*, creating a SODA document collection creates the following in Oracle Database:

- Persistent default collection *metadata*.
- A *table* for storing the collection, in the database schema to which your SODA client is connected.

All SODA implementations provide a *get-metadata* operation, which returns the metadata for a collection, represented in JSON. The *default collection metadata*, which is returned for a default collection, is shown in [Example 1-1](#).

The default metadata specifies a collection that tracks five components for each document: key, content, version, last-modified time stamp, and created-on time stamp. These are specified in JSON by fields `keyColumn`, `contentColumn`, `versionColumn`, `lastModifiedColumn`, and `creationTimeColumn`, respectively. Each of these components is stored in a separate column in the table or view that backs the collection in Oracle Database. The metadata further specifies various details about these components and the database columns that back them.

In [Example 1-1](#), for the key component: the column name is "ID", the column type is "VARCHAR2", the maximum key length is 255, and the key generation method used is "UUID".

In a client application, a document collection is represented in a way that is appropriate to the particular SODA implementation used. For example:

- In SODA for Java, a collection is represented as a Java interface.
- In SODA for PL/SQL, a collection is represented as a PL/SQL object type.
- In SODA for C, a collection is represented as an Oracle Call Interface (OCI) handle.

When a collection is created, the create-collection operation returns a Java or PL/SQL object or an OCI handle, which you can use to perform various collection read and write operations.<sup>3</sup>



 **Note:**

In the SODA for REST URI syntax, after the version component, you can use `custom-actions`, `metadata-catalog`, or a particular collection name. When you use `custom-actions` or `metadata-catalog`, the *next* segment in the URI, if there is one, is a collection name.

Because of this syntax flexibility, you *cannot* have a collection named either `custom-actions` or `metadata-catalog`. An error is raised if you try to create a collection with either of those names using SODA for REST.

In other SODA implementations, besides SODA for REST, nothing prevents you from creating and using a collection named `custom-actions` or `metadata-catalog`. But for possible interoperability, best practice calls for not using these names for collections.

When you create a collection you can specify things such as the following:

- Storage details, such as the name of the table that stores the collection and the names and data types of its columns.
- The presence or absence of columns for creation time stamp, last-modified time stamp, and version.
- Whether the collection can store only JSON documents.
- Methods of document key generation, and whether document keys are client-assigned or generated automatically.
- Methods of version generation.

This configurability also lets you map a new collection to an *existing* database table or view.

To configure a collection in a nondefault way, you must define custom collection metadata and pass it to the create-collection operation. This metadata is represented as JSON data.

---

<sup>3</sup> This is the case only for language-based SODA implementations. In SODA for REST a collection is essentially represented by just a URL.

 **Note:**

You can customize collection metadata to obtain different behavior from that provided by default. However, changing some components requires familiarity with Oracle Database concepts, such as SQL data types. Oracle recommends that you do not change such components unless you have a compelling reason. Because SODA collections are implemented on top of Oracle Database tables (or views), many collection configuration components are related to the underlying table configuration.

For example, if you change the content column type from `BLOB` (the default value) to `VARCHAR2` then you must understand the implications (content size for `VARCHAR2` is limited to 32K bytes, character-set conversion can take place, and so on).

Reasons you might want to use custom metadata include:

- To configure SecureFiles LOB storage.
- To configure a collection to store documents other than JSON (a **heterogeneous collection**).
- To map an existing Oracle Database table or view to a new collection.
- To specify that a collection mapping to an existing table is read-only.
- To use a `VARCHAR2` column for JSON content, and to increase the default maximum length of data allowed in the column.

You might want to increase the maximum allowed data length if your database is configured with extended data types, which extends the maximum length of these data types to 32767 bytes. For more information about extended data types, see *Oracle Database SQL Language Reference*.

 **See Also:**

[SODA Collection Metadata Components \(Reference\)](#) for information about the SODA collection metadata components

You can perform read and write operations on a collection only if it is open. *Opening* a collection amounts to obtaining an object (in Java and PL/SQL) or a handle (in C) that represents the collection. *Creating* a collection opens it automatically: the create-collection operation returns a collection object or handle. There is also an open operation, to open an existing collection. It too returns a collection object or handle. If you try to create a collection, and a collection with the same name already exists, then that existing collection is simply opened.

 **Note:**

By default, the table name for a collection is derived from the collection name, but it can also be explicitly provided in the custom collection metadata that you pass to the create-collection operation. If this table name (derived or explicitly provided) matches an existing table in the currently connected database schema (user), the create-collection operation tries to use that existing table to back the collection.<sup>4</sup>

You must therefore *ensure that the existing table matches the collection metadata*. For example, if the collection metadata specifies that the collection has three columns, for key, content, and version, then the underlying table must have these same columns, and the column types must match those specified in the collection metadata. The create-collection operation performs minimal validation of the existing table, to check that it matches collection metadata. If this check determines that the table and metadata do not match then the create-collection operation raises an error.

 **Caution:**

Do *not* use SQL to drop the database *table* that underlies a collection. Dropping a *collection* involves more than just dropping its database table. In addition to the documents that are stored in its table, a collection has *metadata*, which is also persisted in Oracle Database. Dropping the table underlying a collection does *not* also drop the collection metadata.

**Example 1-1 Default Collection Metadata**

```
{
  "schemaName" : "mySchemaName",
  "tableName" : "myTableName",
  "keyColumn" :
  {
    "name" : "ID",
    "sqlType" : "VARCHAR2",
    "maxLength" : 255,
    "assignmentMethod" : "UUID"
  },
  "contentColumn" :
  {
    "name" : "JSON_DOCUMENT",
    "sqlType" : "BLOB",
    "compress" : "NONE",
    "cache" : true,
    "encrypt" : "NONE",
    "validation" : "STANDARD"
  },
}
```

<sup>4</sup> SODA for REST is an exception here. for security reasons, in this context an error is raised for SODA for REST, to disallow access to existing tables using REST operations.

```
"versionColumn" :
{
  "name" : "VERSION",
  "method" : "SHA256"
},
"lastModifiedColumn" :
{
  "name" : "LAST_MODIFIED"
},
"creationTimeColumn" :
{
  "name" : "CREATED_ON"
},
"readOnly" : false
}
```

### Related Topics

- [SODA Collection Metadata Components \(Reference\)](#)  
Collection metadata is composed of multiple components. A detailed definition of the components is presented.
- [Default Naming of a Collection Table](#)  
By default, the name of the database table that underlies a document collection is derived from the collection name.

## 1.3 Default Naming of a Collection Table

By default, the name of the database table that underlies a document collection is derived from the collection name.

If you want a different table name from that provided by default then use custom collection metadata to explicitly provide the name.

The *default table name* is derived from the collection name you provide, as follows:

1. Each ASCII control character and double quotation mark character (") in the collection name is replaced by an underscore character (\_).
2. If *all* of the following conditions apply, then all letters in the name are converted to *uppercase*, to provide the table name. In this case, you need not quote the table name in SQL code; otherwise, you must quote it.
  - The letters in the name are either all lowercase or all uppercase.
  - The name begins with an ASCII letter.
  - Each character in the name is alphanumeric ASCII, an underscore (\_), a dollar sign (\$), or a number sign (#).

#### Note:

Oracle recommends that you do *not* use dollar-sign characters (\$) or number-sign characters (#) in Oracle identifier names.

For example:

- Collection names "col" and "COL" both result in a table named "COL". When used in SQL, the table name is interpreted case-insensitively, so it need not be enclosed in double quotation marks (").
- Collection name "myCol" results in a table named "myCol". When used in SQL, the table name is interpreted case-sensitively, so it must be enclosed in double quotation marks (").

#### **Related Topics**

- [Table or View](#)  
The collection metadata component that specifies the name of the table or view to which the collection is mapped.

# 2

## Overview of SODA Filter Specifications (QBEs)

A **filter specification** is a pattern expressed in JSON. You use it to select, from a collection, the JSON documents whose content matches it, meaning that the condition expressed by the pattern evaluates to true for the content of (only) those documents.

A filter specification is also called a **query-by-example (QBE)**, or simply a **filter**.

Because a QBE selects documents from a collection, you can use it to *drive read and write operations* on those documents. For example, you can use a QBE to remove all matching documents from a collection.

Each SODA implementation that supports query-by-example provides its own way to query JSON documents. They all use a SODA filter specification to define the data to be queried. For example, with SODA for REST you use an HTTP POST request, passing URI argument `action=query`, and providing the filter specification in the POST body.

QBE patterns use *operators* for this document selection or matching, including condition operators, which perform operations such as field-value comparison or testing for field existence, and logical combining operators for union (`$or`) and intersection (`$and`).

A QBE **operator** occurs in a QBE as a *field* of a JSON object. The associated field value is the **operand** on which the operator acts. SODA operators are predefined fields whose names start with a dollar sign, `$`.

For example, in this QBE, the object that is the value of field `age` has as its only field the operator `$gt`, and the associated operand is the numeric value 45:

```
{ "age" : { "$gt" : 45 } }
```

### Note:

Query-by-example is *not* supported on a *heterogeneous collection*, that is, a collection that has the media type column. Such a collection is designed for storing both JSON and non-JSON content. QBE is supported only for collections that contain only JSON documents.

- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

- [Overview of Paths in SODA QBEs](#)  
A filter specification, or query-by-example (QBE), contains zero or more *paths* to fields in JSON documents. A path to a field can have multiple *steps*, and it can cross the boundaries of objects and arrays.
- [Overview of QBE Comparison Operators](#)  
A query-by-example (QBE) comparison operator tests whether a given JSON object field satisfies some conditions.
- [Overview of QBE Operator \\$not](#)  
Query-by-example (QBE) operator `$not` negates the behavior of its operand, which is a JSON object containing one or more comparison clauses, which are implicitly ANDed.
- [Overview of QBE Item-Method Operators](#)  
A query-by-example (QBE) item-method operator acts on a JSON-object field value to modify or transform it in some way (or simply to filter it from the query result set). Other QBE operators that would otherwise act on the field value then act on the transformed field value instead.
- [Overview of QBE Logical Combining Operators](#)  
You use the query-by-example (QBE) logical combining operators, `$and`, `$or`, and `$nor`, to combine conditions to form more complex QBEs. Each accepts an array of conditions as its argument.
- [Overview of Nested Conditions in QBEs](#)  
You can use a query-by-example (QBE) with a *nested* condition to match a document that has a field with an *array* value with object elements, where a *given element of the array satisfies multiple criteria*.
- [Overview of QBE Operator \\$id](#)  
Other query-by-example (QBE) operators generally look for particular JSON fields within documents and try to match their values. Operator `$id` is an exception in that it instead matches document *keys*. It thus matches document *metadata*, not document content. You use operator `$id` in the outermost condition of a QBE.
- [Overview of QBE Operator \\$orderby](#)  
Query-by-example (QBE) operator `$orderby` is described. It sorts query results in ascending or descending order.
- [Overview of QBE Spatial Operators](#)  
You can use query-by-example (QBE) operator `$near`, `$intersects`, or `$within` to select documents that have a field whose value is a GeoJSON geometry object that is *near* a specified position, *intersects* a specified geometric object, or is *within* another specified geometric object, respectively.

### Related Topics

- [SODA Paths \(Reference\)](#)  
SODA filter specifications contain paths, each of which targets a value in a JavaScript Object Notation (JSON) document. A path is composed of a series of steps. A detailed definition of SODA paths is presented.
- [SODA Filter Specifications \(Reference\)](#)  
You can select JSON documents in a collection by pattern-matching. A detailed definition of SODA filter specifications (QBEs) is presented.
- [Media Type Column Name](#)  
The collection metadata component that specifies the name of the column that stores the media type of the document. A media type column is needed if the

collection is to be heterogeneous, that is, it can store documents other than JavaScript Object Notation (JSON).

**See Also:**

Introducing JSON for information about JSON

## 2.1 Sample JSON Documents

A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

### Example 2-1 Sample JSON Document 1

```
{ "name"      : "Jason",
  "age"       : 45,
  "address"  : [ { "street" : "25 A street",
                  "city"   : "Mono Vista",
                  "zip"    : 94088,
                  "state"  : "CA" } ],
  "drinks"   : "tea" }
```

### Example 2-2 Sample JSON Document 2

```
{ "name"      : "Mary",
  "age"       : 50,
  "address"  : [ { "street" : "15 C street",
                  "city"   : "Mono Vista",
                  "zip"    : 97090,
                  "state"  : "OR" },
                { "street" : "30 ABC avenue",
                  "city"   : "Markstown",
                  "zip"    : 90001,
                  "state"  : "CA" } ] }
```

### Example 2-3 Sample JSON Document 3

```
{ "name"      : "Mark",
  "age"       : 65,
  "drinks"   : ["soda", "tea"] }
```

### Related Topics

- [Field-Condition Clause \(Reference\)](#)

A field-condition clause specifies that a given object field must satisfy a given set of criteria. It constrains a field using one or more condition-operator clauses, each of which is a comparison clause, a not clause, or an item-method clause.



## 2.2 Overview of Paths in SODA QBEs

A filter specification, or query-by-example (QBE), contains zero or more *paths* to fields in JSON documents. A path to a field can have multiple *steps*, and it can cross the boundaries of objects and arrays.

(In the context of a QBE, the term "path to a field" is sometimes shortened informally to "*field*".)

For example, this QBE matches all JSON documents where a `zip` field exists under field `address` and has value `94088`:

```
{ "address.zip" : 94088 }
```

The path in the preceding QBE is `address.zip`, which matches [Example 2-1](#).

### Note:

A SODA QBE is itself a JSON object. You must use *strict* JSON syntax in a QBE. In particular, you must enclose all field names in double quotation marks (`"`). This includes field names, such as `address.zip`, that act as SODA paths. For example, you must write `{"address.zip" : 94088}`, not `{address.zip : 94088}`.

Paths can target a particular element of an array in a JSON document, by enclosing the array *position* of the element in square brackets (`[` and `]`).

For example, path `address[1].zip` targets all `zip` fields in the *second* object of array `addresses`. (Array position numbers start at 0, not 1.) The following QBE matches [Example 2-2](#) because the second object of its `address` array has a `zip` field with value `90001`.

```
{ "address[1].zip" : 90001 }
```

Instead of specifying a single array position, you can specify a list of positions (for example, `[1,2]`) or a range of positions (for example, `[1 to 3]`). The following QBE matches [Example 2-3](#) because it has `"soda"` as the first element (position 0) of array `drinks`.

```
{ "drinks[0,1]" : "soda" }
```

And this QBE does not match any of the sample documents because they do not have `"soda"` as the second or third array element (position 1 or 2).

```
{ "drinks[1 to 2]" : "soda" }
```

If you do not specify an array step then `[*]` is assumed, which matches *any* array element — the asterisk, `*`, acts as a *wildcard*. For example, if the value of field `drinks`

is an array then the following QBE matches a document if the value of any array element is the string "tea":

```
{"drinks" : "tea"}
```

This QBE thus matches sample documents 1 and 2. An equivalent QBE that uses the wildcard explicitly is the following:

```
{"drinks[*]" : "tea"}
```

### Related Topics

- [SODA Paths \(Reference\)](#)  
SODA filter specifications contain paths, each of which targets a value in a JavaScript Object Notation (JSON) document. A path is composed of a series of steps. A detailed definition of SODA paths is presented.
- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

#### See Also:

*Oracle Database JSON Developer's Guide* for information about strict and lax JSON syntax

## 2.3 Overview of QBE Comparison Operators

A query-by-example (QBE) comparison operator tests whether a given JSON object field satisfies some conditions.

One of the simplest and most useful filter specifications tests a field for equality to a specific value. For example, this filter specification matches any document that has a field `name` whose value is "Jason". It uses the QBE operator `$eq`, which tests field-value equality.

```
{ "name" : { "$eq" : "Jason" } }
```

For convenience, for such a scalar-equality QBE you can generally omit operator `$eq`. This scalar-equality filter specification is thus equivalent to the preceding one, which uses `$eq`:

```
{ "name" : "Jason" }
```

Both of the preceding filter specifications match [Example 2-1](#).

The comparison operators are the following:

- `$all` — whether an array field value contains all of a set of values

- `$between` — whether a field value is between two string or number values (inclusive)
- `$eq` — whether a field value is equal to a given scalar
- `$exists` — whether a given field exists
- `$gt` — whether a field value is greater than a given scalar value
- `$gte` — whether a field value is greater than or equal to a given scalar
- `$hasSubstring` — whether a string field value has a given substring (same as `$instr`)
- `$in` — whether a field value is a member of a given set of scalar values
- `$instr` — whether a string field value has a given substring (same as `$hasSubstring`)
- `$like` — whether a field value matches a given SQL `LIKE` pattern
- `$lt` — whether a field value is less than a given scalar value
- `$lte` — whether a field value is less than or equal to a given scalar value
- `$ne` — whether a field value is different from a given scalar value
- `$nin` — whether a field value is not a member of a given set of scalar values
- `$regex` — whether a string field value matches a given regular expression
- `$startsWith` — whether a string field value starts with a given substring

You can combine multiple comparison operators in the object that is the value of a single QBE field. The operators are implicitly ANDed. For example, the following QBE uses comparison operators `$gt` and `$lt`. It matches [Example 2-2](#), because that document contains an `age` field with a value (50), which is both greater than 45 and less than 55.

```
{ "age" : { "$gt" : 45, "$lt" : 55 } }
```

#### Note:

Both the operand of a SODA operator and the data matched in your documents by a QBE are JSON data. But a comparison operator can in some cases *interpret* such JSON values specially before comparing them. The use of *item-method* operators can specify that a comparison should first interpret JSON string data as, for example, uppercase or as a date or a time stamp (date with time). This is explained in the sections about item-method operators.

#### Related Topics

- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

- [Overview of QBE Operator \\$not](#)  
Query-by-example (QBE) operator \$not negates the behavior of its operand, which is a JSON object containing one or more comparison clauses, which are implicitly ANDed.
- [Field-Condition Clause \(Reference\)](#)  
A field-condition clause specifies that a given object field must satisfy a given set of criteria. It constrains a field using one or more condition-operator clauses, each of which is a comparison clause, a not clause, or an item-method clause.
- [Comparison Clause \(Reference\)](#)  
A **comparison clause** is an object member whose field is a *comparison operator*.  
Example: "\$gt" : 200.
- [Overview of QBE Item-Method Operators](#)  
A query-by-example (QBE) item-method operator acts on a JSON-object field value to modify or transform it in some way (or simply to filter it from the query result set). Other QBE operators that would otherwise act on the field value then act on the transformed field value instead.

## 2.4 Overview of QBE Operator \$not

Query-by-example (QBE) operator \$not negates the behavior of its operand, which is a JSON object containing one or more comparison clauses, which are implicitly ANDed.

When any of those clauses evaluates to false, the application of \$not to them evaluates to true. When all of them evaluate to true, it evaluates to false.

For example, this QBE matches [Example 2-1](#) and [Example 2-3](#): document 1 has a field matching path `address.zip` and whose value is *not* "90001", and document 3 has *no* field matching path `address.zip`.

```
{"address.zip" : {"$not" : {"$eq" : "90001"}}
```

The \$not operand in the following QBE has two comparison clauses. It too matches [Example 2-1](#) and [Example 2-3](#), because each of them has an `age` field whose value is *not* both greater than 46 and less than 65.

```
{"age" : {"$not" : {"$gt" : 46, "$lt" : 65}}}
```

### Related Topics

- [Logical Combining Clause \(Reference\)](#)  
A logical combining clause combines the effects of multiple non-empty filter conditions.
- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

## 2.5 Overview of QBE Item-Method Operators

A query-by-example (QBE) item-method operator acts on a JSON-object field value to modify or transform it in some way (or simply to filter it from the query result set). Other

QBE operators that would otherwise act on the field value then act on the transformed field value instead.

Suppose you want to select documents whose string-valued field `name` starts with “Jo”, irrespective of letter case, so that you find matches for `name` values “Joe”, “joe”, “JOE”, “joE”, “Joey”, “joseph”, “josé”, and so on. You might think of using operator `$startsWith`, but that matches string prefixes literally, considering `J` and `j` as different characters, for example.

This is where an *item-method operator* can come in. Your QBE can use item-method operator `$upper` to, in effect, *transform* the raw field data, whether it is “Joey” or “josé”, to an uppercase string, before operator `$startsWith` is applied to test it.

The following QBE matches the prefix of the value of field `name`, but only after converting it to uppercase. The uppercase value is matched using the condition that it starts with `JO`.

```
{ "name" : { "$upper" : { "$startsWith" : "JO" } } }
```

As another example, suppose that you have documents with a string-valued field `deadline` that uses an ISO 8601 date-with-time format supported by SODA, and you want to select those documents whose `deadline` is prior to 7:00 am, January 31, 2019, UTC. You can use item-method operator `$timestamp` to convert the field string values to UTC *time* values (not strings), and then perform a time comparison using an operator such as `$lt`. This QBE does the job:

```
{ "deadline" : { "$timestamp" : { "$lt" : "2019-01-31T07:00:00Z" } } }
```

That matches each of the following `deadline` field values, because each of them represents a time prior to the one specified in the QBE. (The last two represent the exact same time, since 7 pm in a time zone that is 3 hours behind UTC is the same as 10 pm UTC.)

- { "deadline" : "2019-01-28T14:59:43Z" }
- { "deadline" : "2019-01-30T22:00:00Z" }
- { "deadline" : "2019-01-30T19:00:00-03:00" }

Not all item-method operators convert data to a given data type. Some perform other kinds of conversion. Operator `$upper`, for instance, converts a string value to uppercase — the result is still a string.

Some item-method operators even return data that is wholly different from the field values they are applied to. Operator `$type`, for instance, returns a string value that names the JSON data type of the field value.

So for example, this QBE selects only [Example 2-3](#) of the three sample documents, because it is the only one that has a `drinks` field whose value is an array (`[ "soda", "tea" ]`). In particular, it does not match [Example 2-1](#), even though that document has a field `drinks`, because the value of that field is the string `"tea"` — a scalar, not an array.

```
{ "drinks" : { "$type" : "array" } }
```

 **Note:**

An item-method field (operator) does not, itself, use or act on its associated value (its operand). Instead, it acts on the value of the JSON data that *matches its parent field*.

For example, in the QBE `{"birthday" : {"$date" : {"$gt" : "2000-01-01" }}}`, item-method operator `$date` acts on the JSON data that matches its parent field, `birthday`. It does not use or act on its operand, which is the JSON object (a comparison clause in this case) `{"$gt" : "2000-01-01"}`. The `birthday` data (a JSON string of format ISO 8601) in your JSON document is interpreted as a date, and that date is then matched against the condition that it be greater than the date represented by the (ISO date) string `"2000-01-01"` (later than January 1, 2000).

This can take some getting used to. The operand is used after the item-method operator does its job. It is matched against the *result of the action* of the operator on the value of its *parent* field. A item-method operator is a *filter* of sorts — it stands syntactically *between* the field (to its left) that matches the data it acts on and (to its right) some tests that are applied to the result of that action.

 **Note:**

- To use item method operator `$abs`, `$date`, `$size`, `$timestamp`, or `$type` you need Oracle Database Release 18c or later.
- To use any other item method you need Oracle Database Release 12c (12.2.0.1) or later.

**Related Topics**

- [Item-Method Clause \(Reference\)](#)  
An **item-method clause** is an *item-method equality clause* or an *item-method modifier clause*. It applies an *item method* to the field of the field-condition clause in which it appears, typically to *modify* the field value. It then matches the result against the operand of the item-method.
- [ISO 8601 Date and Time Support](#)  
International Standards Organization (ISO) standard 8601 describes an internationally accepted way to represent dates and times. Oracle Database supports many of the ISO 8601 date and time formats.

## 2.6 Overview of QBE Logical Combining Operators

You use the query-by-example (QBE) logical combining operators, `$and`, `$or`, and `$nor`, to combine conditions to form more complex QBEs. Each accepts an array of conditions as its argument.

QBE logical combining operator `$and` matches a document if each condition in its array argument matches it. For example, this QBE matches [Example 2-1](#), because that

document contains a field `name` whose value starts with "Ja", *and* it contains a field `drinks` whose value is "tea".

```
{"$and" : [ {"name" : {"$startsWith" : "Ja"}}, {"drinks" : "tea"} ] }
```

Often you can omit operator `$and` — it is implicit. For example, the following query is equivalent to the previous one:

```
{"name" : {"$startsWith" : "Ja"}, "drinks" : "tea" }
```

QBE logical combining operator `$or` matches a document if at least one of the conditions in its array argument matches it.

For example, the following QBE matches [Example 2-2](#) and [Example 2-3](#), because those documents contain a field `drinks` whose value is "soda" *or* they contain a field `zip` under a field `address`, where the value of `address.zip` is less than 94000, or they contain both:

```
{"$or" : [ {"drinks" : "soda"}, {"address.zip" : {"$lte" : 94000}} ] }
```

QBE logical combining operator `$nor` matches a document if *no* condition in its array argument matches it. (Operators `$nor` and `$or` are logical complements.)

The following query matches sample document 1, because in that document there is *neither* a field `drinks` whose value is "soda" *nor* a field `zip` under a field `address`, where the value of `address.zip` is less than 94000:

```
{"$nor" : [ {"drinks" : "soda"}, {"address.zip" : {"$lte" : 94000}} ] }
```

Each element in the array argument of a logical combining operator is a condition.

For example, the following condition has a single logical combining clause, with operator `$and`. The array value of `$and` has two conditions: the first condition restricts the value of field `age`. The second condition has a single logical combining clause with `$or`, and it restricts either the value of field `name` or the value of field `drinks`.

```
{ "$and" : [ { "age" : {"$gte" : 60} },
              { "$or" : [ {"name" : "Jason"},
                          {"drinks" : {"$in" : ["tea", "soda"]}} ] } ] }
```

- The condition with the comparison for field `age` matches sample document 3.
- The condition with logical combining operator `$or` matches sample documents 1 and 3.
- The *overall* condition matches only sample document 3, because that is the only document that satisfies *both* the condition on `age` *and* the condition that uses `$or`.

The following condition has two conditions in the array argument of operator `$or`. The first of these has a single logical combining clause with `$and`, and it restricts the values

of fields `name` and `drinks`. The second has a single logical combining clause with `$nor`, and it restricts the values of fields `age` and `name`.

```
{ "$or" : [ { "$and" : [ { "name" : "Jason"},
                        { "drinks" : { "$in" : ["tea", "soda"]} } ] },
            { "$nor" : [ { "age" : { "$lt" : 65}},
                        { "name" : "Jason" } ] } ] ] }
```

- The condition with operator `$and` matches sample document 1.
- The condition with operator `$nor` matches sample document 3.
- The *overall* condition matches both sample documents 1 and 3, because each of these documents satisfies *at least one* condition in the `$or` argument.

### Related Topics

- [Logical Combining Clause \(Reference\)](#)  
A logical combining clause combines the effects of multiple non-empty filter conditions.
- [Omitting \\$and](#)  
Sometimes you can omit the use of `$and`.
- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

## 2.7 Overview of Nested Conditions in QBEs

You can use a query-by-example (QBE) with a *nested* condition to match a document that has a field with an *array* value with object elements, where a *given element of the array satisfies multiple criteria*.

The following condition matches documents that have both a `city` value of "Mono Vista" and a `state` value of "CA" in the *same object* under `address`.

```
{"address" : { "city" : "Mono Vista", "state" : "CA"}}
```

It specifies that there must be a *parent* field `address`, and if the value of that field is an *array* then at least one object in the array must have a `city` field with value "Mono Vista" *and* a `state` field with value "CA". Of the three sample JSON documents, this QBE matches only [Example 2-1](#).

The following QBE also matches sample document 1, but it matches [Example 2-2](#) as well:

```
{"address.city" : "Mono Vista", "address.state" : "CA"}
```

Unlike the preceding QBE, nothing here constrains the city and state to belong to the *same* address. Instead, this QBE specifies only that matching documents must have a `city` field with value "Mono Vista" *in some object* of an `address` array and a `state` field with value "CA" *in some object* of an `address` array. It does not specify that fields `address.city` and `address.state` must reside within the *same object*.



### Related Topics

- [Nested-Condition Clause \(Reference\)](#)  
A **nested-condition clause** consists of a parent field followed by a single, non-empty filter condition. All fields contained in this **nested condition** are scoped to the parent field.
- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

## 2.8 Overview of QBE Operator \$id

Other query-by-example (QBE) operators generally look for particular JSON fields within documents and try to match their values. Operator `$id` is an exception in that it instead matches document *keys*. It thus matches document *metadata*, not document content. You use operator `$id` in the outermost condition of a QBE.

[Example 2-4](#) shows three QBEs that use operator `$id`.

### Example 2-4 Using \$id To Find Documents That Have Given Keys

```
// Find the unique document that has key "key1".
{"$id" : "key1"}

// Find the documents that have any of the keys "key1", "key2", and "key3".
{"$id" : ["key1","key2","key3"]}

// Find the documents that have at least one of the keys "key1" and "key2",
// and that have an object with a field address.zip whose value is at
// least 94000.
{"$and" : [{ $id : ["key1", "key2"] },
           { "address.zip" : { "$gte" : 94000 } } ] }
```

### Related Topics

- [ID Clause \(Reference\)](#)  
Other query-by-example (QBE) operators generally look for particular JSON fields within the content of documents and try to match their values. An **ID clause**, which uses operator `$id`, instead matches document *keys*. It thus matches document *metadata*, not document content.

## 2.9 Overview of QBE Operator \$orderby

Query-by-example (QBE) operator `$orderby` is described. It sorts query results in ascending or descending order.

You can specify the sort order for individual fields and the relative sort order among fields.

Operator `$orderby` can be used with two alternative syntaxes: array and abbreviated.

Regardless of the syntax choice, when you use `$orderby` in a filter specification together with one or more filter conditions, you must wrap those conditions with operator `$query`. In the queries shown here, the returned documents are restricted to

those that satisfy a filter condition that specifies that field `age` must have a value greater than 40.

### Using the Orderby Clause Array Syntax

The *array* syntax is the more straightforward of the two. You follow `$orderby` by an array of the fields to sort, in their *relative sort order*: the first array element specifies the first field to sort by, the second element specifies the second field to sort by, and so on.

The array syntax also lets you specify the *SQL data type to use for sorting a given field*, that is, how to interpret the field values, for sorting purposes.

For example, you can specify whether a field that has numeric codes (as a string or as a number) should be sorted lexicographically (as a string of digit characters) or numerically as a sequence of digits interpreted as a number). With `"varchar2"` as the sort data type, `"100"` sorts, in ascending order, before `"9"`. With `"number"` as the sort type, `"9"` sorts, in ascending order, before `"100"`, since the number 9 is smaller than the number 100.

#### Note:

To use a datatype value of `date` or `timestamp` you need Oracle Database Release 18c or later.

Finally, the array syntax also lets you specify, for a string-valued field, a maximum number of characters at the start of the string. An error is raised if a string value for the targeted field is too long.

The following QBE selects objects in which field `salary` is between 10,000 and 20,000, inclusive. It sorts the objects first by descending `age`, interpreted as a number, then by ascending `name`, interpreted as a string. An error is raised if the string value of field `name` is longer than 100 characters in any matching document. The default error handling also applies: raise an error if the value of any of the specified fields is not convertible to the specified `datatype`, but do not raise an error just because some of the specified fields are missing.

```
{ "$query" : { "salary" : { "$gt" : 10000, "$lte" : 20000 } },
  "$orderby" : [ { "path" : "age",
                  "datatype" : "number",
                  "order" : "desc" },
                { "path" : "name",
                  "datatype" : "varchar2",
                  "order" : "asc",
                  "maxLength" : 100 } ] }
```

The following QBE is the same, except that it specifies `scalarRequired = true`, to require that field `name` be present in each matching document (as well as requiring that its value be convertible to a string). Otherwise, an error is raised at query time.

```
{ "$query" : { "salary" : { "$gt" : 10000, "$lte" : 20000 } },
  "$orderby" : { "$fields" :
```

```
[ { "path" : "age",
    "datatype" : "number",
    "order" : "desc" },
  { "path" : "name",
    "datatype" : "varchar2",
    "order" : "asc",
    "maxLength" : 100 } ],
"$scalarRequired" : true } }
```

### Using the Orderby Clause Abbreviated Syntax

The abbreviated syntax lets you list the fields to sort by and their relative sort order in a succinct way. You cannot use it to specify how to interpret the values of a given field for sorting purposes, that is, which data type to interpret the values as. And you cannot specify a maximum number of characters to take into account when sorting a string field.

The following QBE specifies the order of fields `age` and `name` when sorting documents where the `salary` is between 10,000 and 20,000. A value of `-1` specifies *descending* order for `age`. A value of `2` specifies *ascending* order for `name`. Sorting is done *first* by `age` and then by `name`, because the absolute value of `-1` is less than the absolute value of `2` — not because `-1` is less than `2`, and not because field `age` appears before field `name` in the `$orderby` object.

```
{ "$query" : { "salary" : { $between [10000, 20000] } },
  "$orderby" : { "age" : -1, "name" : 2 } }
```

### Related Topics

- [Orderby Clause Sorts Selected Objects](#)  
A filter specification (query-by-example, or QBE) with an `orderby` clause returns the selected JSON documents in sorted order.

## 2.10 Overview of QBE Spatial Operators

You can use query-by-example (QBE) operator `$near`, `$intersects`, or `$within` to select documents that have a field whose value is a GeoJSON geometry object that is *near* a specified position, *intersects* a specified geometric object, or is *within* another specified geometric object, respectively.



#### Note:

To use QBE spatial operators you need Oracle Database Release 12c (12.2.0.1) or later.

The following QBE selects only documents that have a `location` field whose value is a `Point` GeoJSON geometry object that represents a position within 50 kilometers of the coordinates `[34.0162, -118.2019]`.

```
{ "location" :
  { "$near" :
```

```

    { "$geometry" : { "type" : "Point", "coordinates" : [34.0162,
-118.2019] },
      "$distance" : 50,
      "$unit"      : "KM" } } }

```

It can retrieve a document that has an object such as this one, for example:

```

{ "location" : { "type" : "Point", "coordinates": [33.7243, -118.1579] } }

```

Any document that does not contain a `location` field is ignored (skipped) without error. But if the queried collection contains a document with a `location` field that does *not* have as value a (single) GeoJSON geometry object then an error is raised. A document with this object, for example, raises an error:

```

{ "location" : "1600 Pennsylvania Ave NW, Washington, DC 20500" }

```

You can provide different (non-default) error-handling behavior for your QBE by including a true-valued `$scalarRequired` or `$lax` field (but *not* both together) in the object that is the value of spatial operator `$near`, `$intersects`, or `$within`.

- A true value for field `$scalarRequired` means raise an error if any document does not have a `location` field. (An error is still also raised for a `location` field whose value is not a geometry object.)
- A true value for field `$lax` means ignore not only a missing `location` field but also a `location` field whose value is not a GeoJSON geometry object.

For example, this QBE raises an error if any document has *no* `location` field or if any document has a `location` field whose value is not a geometry object:

```

{ "location" :
  { "$near" :
    { "$geometry"      : { "type" : "Point", "coordinates" : [34.0162,
-118.2019] },
      "$distance"     : 50,
      "$unit"         : "KM",
      "$scalarRequired : true } } }

```

And this QBE does *not* raise an error for a document that has no `location` field or for a document that has a `location` field whose value is not a geometry object:

```

{ "location" :
  { "$near" :
    { "$geometry" : { "type" : "Point", "coordinates" : [34.0162,
-118.2019] },
      "$distance" : 50,
      "$unit"     : "KM",
      "$lax"      : true } } }

```

 **Note:**

If you have created a SODA spatial index, for a field whose value is a GeoJSON `geometry` object, and you use a QBE that targets that field, the index can be picked up for the QBE *only* if both index and QBE specify the *same* error-handling behavior for that field. Both must specify the *same one* of these:

- `scalarRequired : true`
- `lax : true`
- Neither `scalarRequired : true` nor `lax : true`

### Related Topics

- [Spatial Clause \(Reference\)](#)  
GeoJSON objects are JSON objects that represent geographic data. You can use a SODA QBE spatial clause to match GeoJSON geometry objects in your documents.
- [SODA Index Specifications \(Reference\)](#)  
You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

# 3

## Overview of SODA Indexing

The performance of SODA QBEs can sometimes be improved by using indexes. You define a SODA index with an index specification, which is a JSON object that specifies how particular QBE patterns are to be indexed for quicker matching.

Suppose that you often use a query such as `{"dateField" : {"$date" : DATE-STRING}}`, where *DATE-STRING* is a string in an ISO 8601 format supported by SODA. Here, item method `$date` transforms *DATE-STRING* to a SQL value of data type *DATE*. You can typically improve the performance of queries on a field such as "dateField" by creating a *B-tree index* for it.

Or suppose that you want to query spatial data in a GeoJSON geometry object. You can improve the performance of such queries by creating a SODA spatial index for that data.

Or suppose that you want to be able to perform full-text queries using QBE operator `$contains`. You can enable such queries by creating a *JSON search index* for your data.

Or suppose that you want to perform metadata queries on a *JSON data guide*, which is a summary of the structural and type information about a set of JSON documents. You can create a JSON search index that holds and automatically updates such data-guide information.

In all such cases you specify the index you want by creating a SODA *index specification* and then using it to create the specified index.

Each SODA implementation that supports indexing provides a way to create an index. They all use a SODA **index specification** to define the index to be created. For example, with SODA for REST you use an HTTP POST request, passing URI argument `action=index`, and providing the index specification in the POST body.

### Note:

- To create a B-tree index you need Oracle Database Release 12c (12.2.0.1) or later.  
To create a B-tree index that indexes a *DATE* or a *TIMESTAMP* value you need Oracle Database Release 18c (18.1) or later.
- To create a spatial index you need Oracle Database Release 12c (12.2.0.1) or later.
- To create a search index you need Oracle Database Release 12c (12.2.0.1) or later.

### Example 3-1 Specifying a B-Tree Index

This example specifies a B-tree non-unique index for numeric field `address.zip`.

```
{ "name"    : "ZIPCODE_IDX",
  "fields" : [ { "path"    : "address.zip",
                 "datatype": "number",
                 "order"   : "asc" } ] }
```

This indexes the field at path `address.zip` in [Example 2-1](#) and [Example 2-2](#).

[Example 2-3](#) has no such field, so that document is skipped during indexing.

You can specify that the index requires that all indexed fields be scalar by including `scalarRequired : true` in the index specification:

```
{ "name"    : "ZIPCODE_IDX",
  "fields" : [ { "path"    : "address.zip",
                 "datatype": "number",
                 "order"   : "asc" } ],
  "scalarRequired" : true }
```

If a specification includes `scalarRequired : true`, and if the collection contains a document that is missing one or more of the specified fields (just `address.zip` in this case), or if any of them has a non-scalar value, then an error is raised when creating the index. In addition, if such an index exists when you try to write a document that lacks that one of the indexed fields then an error is raised for the write operation.

Regardless of the value of `scalarRequired`, an error is raised if you try to write a document that has the targeted field but with a value that is not convertible to the specified data type. For example, for the index defined in [Example 3-1](#), if a document contains field `address.zip`, but the field value is not convertible to a number, then an error is raised. This would be the case, for instance, for a `zip` field whose value is an object.

### Example 3-2 Specifying a Spatial Index

This example specifies an Oracle Spatial and Graph index named `LOCATION_LONG_LAT_IDX`, which indexes the GeoJSON geometry object that is the value of field `location` in your documents:

```
{ "name"    : "LOCATION_LONG_LAT_IDX",
  "spatial" : "location" }
```

This index specification applies to all documents that have a `location` field whose value is a GeoJSON geometry object, and only to such documents. Here's an example of an object with such a `location` field, whose value is a geometry object of type `Point`:

```
{ "location" : { "type" : "Point",
                 "coordinates" : [ 33.7243, 118.1579 ] } }
```

That `location` value is indexed, because its value is a GeoJSON geometry object.

Because neither `scalarRequired : true` nor `lax : true` is specified in the index specification, a document that has *no* `location` field is silently skipped (not indexed) during indexing.

And if the collection that is queried has a document with an object such as one of the following, whose `location` values are *not* GeoJSON geometry objects, then an error is raised during indexing.

```
{ "location" : [ 33.7243, 118.1579 ] }
{ "location" : "1600 Pennsylvania Ave NW, Washington, DC 20500" }
```

In addition, if such an index exists, and you try to write a document that has `location` field with such a non-geometry value, then an error is raised for the write operation.

You can specify that the index requires that all indexed fields be scalar by including `scalarRequired : true` in the index specification:

```
{ "name"      : "LOCATION_LONG_LAT_IDX",
  "spatial"   : "location",
  "scalarRequired" : true }
```

With `scalarRequired : true`, if the collection contains a document that has *no* `location` field, then an error is raised when creating the index. In addition, if such an index exists, and you try to write a document that lacks the indexed field (`location`), then an error is raised for the write operation. (An error is still also raised, for index creation or a write operation, for a `location` field whose value is not a geometry object.)

Alternatively you can specify that the index does *not* require indexed fields to be present and have GeoJSON geometry values by including `lax : true` in the index specification:

```
{ "name"      : "LOCATION_LONG_LAT_IDX",
  "spatial"   : "location",
  "lax"       : true }
```

With `lax : true`, *no error* is raised for a document that lacks a `location` field or for a document with a `location` field value (such as `{"location" : [33.7243, 118.1579]}`) that is not a GeoJSON geometry object. The index simply ignores such documents.



 **Note:**

If you have created a SODA spatial index, for a field whose value is a GeoJSON `geometry` object, and you use a QBE that targets that field, the index can be picked up for the QBE *only* if both index and QBE specify the *same* error-handling behavior for that field. Both must specify the *same one* of these:

- `scalarRequired : true`
- `lax : true`
- Neither `scalarRequired : true` nor `lax : true`

**Example 3-3 Specifying a JSON Search Index**

This example specifies a JSON search index. The index does both of these things:

- Enables you to perform ad hoc full-word and full-number queries on your JSON documents.
- Automatically accumulates and updates aggregate structural and type information about your JSON documents.

```
{ "name" : "SEARCH_AND_DATA_GUIDE_IDX" }
```

This index specification is equivalent. It just makes explicit the default values.

```
{ "name"      : "SEARCH_AND_DATA_GUIDE_IDX",
  "dataguide" : "on",
  "search_on" : "text_value" }
```

**Related Topics**

- [SODA Index Specifications \(Reference\)](#)  
You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

 **See Also:**

- *Oracle Database JSON Developer's Guide* for information about using SQL to create `json_value` B-tree indexes
- *Oracle Spatial and Graph Developer's Guide* for information about Oracle Spatial and Graph indexes
- *Oracle Database JSON Developer's Guide* for information about JSON search indexes

# 4

## SODA Paths (Reference)

SODA filter specifications contain paths, each of which targets a value in a JavaScript Object Notation (JSON) document. A path is composed of a series of steps. A detailed definition of SODA paths is presented.

### Note:

A SODA QBE is itself a JSON object. You must use *strict* JSON syntax in a QBE. In particular, you must enclose all field names in double quotation marks ("). This includes field names, such as `address.zip`, that act as SODA paths. For example, you must write `{"address.zip" : 94088}`, not `{address.zip : 94088}`.

The following characters can have special syntactic meaning in some SODA path steps, in which case their use in that context is called **syntactic** (they are **used syntactically**):

- Brackets ([ and ]) delimit a JSON array
- Comma (,) separates array elements or array index components
- Wildcard (\*) is a placeholder that matches any array index in an array step or any field name in a field step (defined below)
- Period (.) separates a parent-object field name (or \*) from a child-object field name (or \*)

In any other path-expression context than those just listed, these same characters have no special syntactic meaning. For example, outside of its use in array syntax a comma is not used syntactically.

A character that is not used syntactically in a given context is **ordinary** in that context. For example, a comma is ordinary outside of its use in array syntax, and the character `d` is always ordinary.

There are two kinds of steps in a path: field steps and array steps.

A **field step** is one of the following:

- The wildcard character \* (by itself)
- A sequence of characters that are always ordinary — for example, `cat`
- A sequence of any characters that is enclosed in backquote characters (``) — for example, ``dog`` and ``cat.dog``

Characters within a field step that is enclosed in *backquote characters* are not used syntactically; they are treated literally. If you intend for a character not to be used syntactically where it normally would be then you must enclose its step in backquote characters.

All of the characters in field name `dog` are always ordinary, so backquote characters are optional in ``dog``. But the following field steps must be enclosed in backquote characters because each contains one or more characters that would otherwise be used syntactically:

```
`cat.dog`
`cat[dog]`
`*`
```

In the path `a.*.b`, the asterisk acts as a wildcard; it is a placeholder for a field name. But in the path `a.`*`.b` the asterisk does not act as a wildcard. Because it is escaped by backquotes it acts as an ordinary character — a field named `*`. (In both cases the unescaped periods are used syntactically.)

Besides using backquotes to inhibit special syntactic meaning, you can use them to escape a dollar-sign character (`$`) at the beginning of a field name, where it would otherwise be interpreted as introducing a SODA operator name. For example, because of the backquote characters, the field step ``$eq`` does not represent SODA operator `$eq`; it represents an ordinary JSON field that has the same name. (Needing to query data that has field names that begin with `$` is rare.)

If a step that you enclose in backquote characters *contains* a backquote character, then you must represent that character using two consecutive backquote characters. For example: ``Customer``s Comment``.

An unescaped period (`.`) must be followed by a field step. After the first step in a path, each field step must be preceded by a period.

An **array step** is delimited by brackets (`[` and `]`). Inside the brackets can be either:

- The wildcard character `*` (by itself)
- One or more of these **array index (position) components**:
  - A single **array index**, which is an integer greater than or equal to zero
  - An **array index range**, which has this syntax:

```
x to y
```

`x` and `y` are integers greater than or equal to zero, and `x` is less than or equal to `y`. There must be at least one whitespace character between `x` and `to` and between `to` and `y`.

Multiple components must be separated by commas (`,`). In a list of multiple components, array indexes must be in ascending order, and ranges cannot overlap.

For example, these are valid array steps:

```
[*]
[1]
[1,2,3]
[1 to 3]
[1, 3 to 5]
```

The following are *not* valid array steps:

```
[*, 6]  
[3, 2, 1]  
[3 to 1]  
[1 to 3, 2 to 4]
```

### Related Topics

- [Overview of Paths in SODA QBEs](#)  
A filter specification, or query-by-example (QBE), contains zero or more *paths* to fields in JSON documents. A path to a field can have multiple *steps*, and it can cross the boundaries of objects and arrays.
- [SODA Filter Specifications \(Reference\)](#)  
You can select JSON documents in a collection by pattern-matching. A detailed definition of SODA filter specifications (QBEs) is presented.

#### See Also:

- *Oracle Database JSON Developer's Guide* for information about strict and lax JSON syntax
- [Introducing JSON](#) for information about JSON

# 5

## SODA Filter Specifications (Reference)

You can select JSON documents in a collection by pattern-matching. A detailed definition of SODA filter specifications (QBEs) is presented.

A **filter specification**, also known as a **query-by-example (QBE)** or simply a **filter**, is a SODA query that uses a pattern expressed in JSON. A QBE is itself a JSON object. SODA query operations use a QBE to select all JSON documents in a collection that satisfy it, meaning that the filter evaluates to true for only those documents. A QBE thus specifies characteristics that the documents that satisfy it must possess.

A filter can use QBE **operators**, which are predefined JSON fields whose names start with a dollar-sign character (\$). The JSON value associated with an operator field is called its **operand** or its argument.<sup>1</sup>

Although a SODA operator is itself a JSON field, for ease of exposition in the context of filter specification descriptions, the term “*field*” generally refers here to a JSON field that is *not* a SODA operator. Also, in the context of a QBE, “*field*” is often used informally to mean “*path to a field*”.

### Note:

You must use *strict* JSON syntax in a SODA filter specification, enclosing each nonnumeric, non-Boolean, and non-null JSON value in double quotation marks ("). In particular, the names of all JSON fields, including SODA operators, must be enclosed in double quotation marks.

A filter specification is a JSON object. There are two kinds of filter specification:

- Composite filter.
- Filter-condition filter.

A filter specification (QBE) can appear only at the top (root) level of a query. However, a filter condition can be used either (a) on its own, as a filter-condition filter (a QBE), or (b) at a lower level, in the query clause of a composite filter.

### Note:

Query-by-example is *not* supported on a *heterogeneous collection*, that is, a collection that has the media type column. Such a collection is designed for storing both JSON and non-JSON content. QBE is supported only for collections that contain only JSON documents.

<sup>1</sup> A syntax error is raised if the argument to a QBE operator is not of the required type (for example, if operator \$gt is passed an argument that is not a string or a number).

- [Composite Filters \(Reference\)](#)  
A composite filter specification (query-by-example, or QBE) can appear only at the top level. That is, you cannot nest a composite filter inside another composite filter or inside a filter condition.
- [Filter Conditions \(Reference\)](#)  
A filter condition can be used either on its own, as a filter specification, or at a lower level, in the query clause of a composite filter specification.

### Related Topics

- [Overview of SODA Filter Specifications \(QBEs\)](#)  
A **filter specification** is a pattern expressed in JSON. You use it to select, from a collection, the JSON documents whose content matches it, meaning that the condition expressed by the pattern evaluates to true for the content of (only) those documents.
- [Media Type Column Name](#)  
The collection metadata component that specifies the name of the column that stores the media type of the document. A media type column is needed if the collection is to be heterogeneous, that is, it can store documents other than JavaScript Object Notation (JSON).



#### See Also:

*Oracle Database JSON Developer's Guide* for information about strict and lax JSON syntax

## 5.1 Composite Filters (Reference)

A composite filter specification (query-by-example, or QBE) can appear only at the top level. That is, you cannot nest a composite filter inside another composite filter or inside a filter condition.

A **composite filter** consists of at most one of each of these clauses:<sup>2</sup>

- Query clause  
It has the form `$query filter_condition`.
- Orderby clause  
It has the form `$orderby orderby_spec`.

The order of the clauses is not significant. Absence of a clause has the same effect as applying its operator to an operand that is an empty object: Absence of a query clause selects all documents; absence of an orderby clause imposes no order.

The following composite filter contains a query clause and an orderby clause. The query clause selects documents that have a `salary` field whose value is greater than

<sup>2</sup> SODA for REST provides additional clauses for use in a composite filter.

10,000. The `orderby` clause sorts the selected documents first by descending `age` and then by ascending `zip` code.

```
{ "$query" : { "salary" : { "gt" : 10000 } },
  "$orderby" : { "age" : -1, "zip" : 2 } }
```

- [Orderby Clause Sorts Selected Objects](#)  
A filter specification (query-by-example, or QBE) with an `orderby` clause returns the selected JSON documents in sorted order.

#### Related Topics

- [Filter Conditions \(Reference\)](#)  
A filter condition can be used either on its own, as a filter specification, or at a lower level, in the query clause of a composite filter specification.

## 5.1.1 Orderby Clause Sorts Selected Objects

A filter specification (query-by-example, or QBE) with an `orderby` clause returns the selected JSON documents in sorted order.

There are two ways of controlling the ordering behavior, with different `orderby`-clause syntaxes:

- An *array* syntax lets you specify the SQL data types used and provides simple control over the field order. Sorting is by the first field specified, then by the second, and so on.

There are two variants of this syntax, depending on whether you need to change the default behavior for handling of errors or empty fields.

- An *abbreviated* syntax does not let you specify the SQL data types used. In its most abbreviated form it also does not provide control over the order of the fields used for sorting.

#### Orderby Clause Array Syntax

The simplest `orderby` array syntax is operator `$orderby` followed by an array of objects, each of which has a `path` field, which targets a particular field from the root of the candidate object, followed by at most one of each of these fields:

- **`datatype`**, which specifies the SQL data type to use — one of: "varchar2" (default), "number", "date", "timestamp", "string" or "varchar". (Values "string" and "varchar" are synonyms for "varchar2".)

These values correspond to SQL data types `VARCHAR2`, `NUMBER`, `DATE`, and `TIMESTAMP`, respectively.

#### Note:

To use a `datatype` value of `date` or `timestamp` you need Oracle Database Release 18c or later.

- **`order`**, which specifies whether the field values are to be in ascending ("`asc`") or descending ("`desc`") order (default: "`asc`")

- **maxLength**, which is a positive integer that specifies the maximum length, in characters, of a targeted string value. If a string exceeds this limit then raise an error. The use of `$lax` (see below) inhibits raising the error and ignores the overlong string for sorting purposes. Field `maxLength` applies only when `datatype` is `"varchar2"`.

For example, this filter specification selects objects in which field `salary` has a value greater than 10,000 and less than or equal to 20,000. It sorts the objects first by descending `age`, interpreted as a number, then by ascending `name`, interpreted as a string.

```
{ "$query" : { "salary" : { "$gt" : 10000, "$lte" : 20000 } },
  "$orderby" :
  [ { "path" : "age", "datatype" : "number", "order" : "desc" },
    { "path" : "name", "datatype" : "varchar2", "order" : "asc" } ] }
```

The following SQL `SELECT` statement fragment is analogous:

```
WHERE (salary > 10000) AND (salary <= 20000) ORDER BY age DESC, name ASC
```

This syntax serves most purposes. No error is raised just because the targeted field is absent, and any other error encountered is raised.<sup>3</sup>

If you need to specify special handling of missing fields or errors then you need to use the more elaborate array syntax. This wraps the array in a `$fields` object, which lets you add another field, `$scalarRequired` or `$lax`, to the `$orderby` object. You cannot specify a `true` value for both `$lax` and `$scalarRequired`, or else a syntax error is raised at query time.

- **\$scalarRequired** — Boolean. *Optional.* When set to `true` the targeted field *must* be present, and its value must be a JSON scalar that is convertible to data type `datatype`. Raise an error at query time if, for any matched document, that is not the case.<sup>4</sup>
- **\$lax** — Boolean. *Optional.* When set to `true` the targeted field need *not* be present or have a value that is a JSON scalar convertible to data type `datatype`. Do not raise an error at query time if, for any matched document, that is the case.<sup>5</sup>

If neither `scalarRequired` nor `lax` is specified as `true` then the default error-handling behavior applies (no error is raised just because the targeted field is absent, and any other error encountered is raised).

For example, this filter specification has the same behavior as the preceding one, except that it raises an error if any of the targeted fields is missing.

```
{ "$query" : { "salary" : { "$gt" : 10000, "$lte" : 20000 } },
  "$orderby" :
  { "$fields" : [ { "path" : "age",
                   "datatype" : "number",
```

<sup>3</sup> The default error-handling behavior corresponds to the SQL/JSON semantics `ERROR ON ERROR NULL ON EMPTY`.

<sup>4</sup> A `true` value of `$scalarRequired` corresponds to the use of SQL clause `ERROR ON ERROR` for a `json_value` expression.

<sup>5</sup> A `true` value of `$lax` corresponds to the use of SQL clause `NULL ON ERROR` for a functional index created on a `json_value` expression.



```

        "order" : "desc" },
    { "path" : "name",
      "datatype" : "varchar2",
      "order" : "asc",
      "maxLength" : 100 } ],
    "$scalarRequired" : true } }

```

 **Note:**

If you use Oracle Database Release 12c (12.1.0.2) then you *must* specify either `$scalarRequired` or `$lax`; otherwise a syntax error is raised.

 **Note:**

If you have defined a B-tree index for any of the fields targeted by a QBE that has an `orderby` clause then that index must be specified with a `true` value of `indexNulls` for it to be picked up for that query.

 **See Also:**

- *Oracle Database JSON Developer's Guide* for information about SQL/JSON error-handling values `ERROR ON ERROR` and `NULL ON ERROR`
- *Oracle Database JSON Developer's Guide* for information about SQL/JSON empty field-handling values `NULL ON EMPTY` and `ERROR ON EMPTY`

### Orderby Clause Abbreviated Syntax

The abbreviated `$orderby` syntax specifies the fields to use for sorting, along with their individual directions and the order of sorting among the fields. It does not specify the SQL data types to use when interpreting field values for sorting, and it does not let you limit string sorting to the first *N* characters.

The `orderby` abbreviated syntax is `$orderby` followed by an object with one or more members, whose fields are used for sorting:

```
"$orderby" : { field1 : direction1, field2 : direction2, ... }
```

Each *field* is a string that is interpreted as a path from the root of the candidate object.

Each *direction* is a non-zero integer. The returned documents are sorted by the *field* value in ascending or descending order, depending on whether the value is positive or negative, respectively.

The fields in the `$orderby` operand are sorted in the *order of their magnitudes* (absolute values), smaller magnitudes before larger ones. For example, a field with

value -1 sorts before a field with value 2, which sorts before a field with value 3. As usual, the order of the fields in the object value of `$orderby` is immaterial.

If the absolute values of two or more sort directions are *equal* then the order in which the fields are sorted is determined by the order in which they appear in the serialized JSON content that you use to create the JSON document.

Oracle recommends that you use sort directions that have *unequal* absolute values, to precisely govern the order in which the fields are used, especially if you use an external tool or library to create the JSON content and you are unsure of the order in which the resulting content is serialized.

This query acts like the one in [Orderby Clause Array Syntax](#), except that interpretation of data types is not specified here, and (assuming that field `name` has string values) *all* characters in the `name` are used for sorting here. Note that the order of the object members is irrelevant here. In particular, it does not specify which field is sorted first — that is determined by the value magnitudes.

```
{ "$query" : { "salary" : { $between [10000, 20000] } },  
  "$orderby" : { "age" : -1, "name" : 2 } }
```

The following SQL `SELECT` statement fragment is analogous:

```
WHERE (salary >= 10000) AND (salary <= 20000) ORDER BY age DESC, name ASC
```

### Related Topics

- [Overview of QBE Operator \\$orderby](#)  
Query-by-example (QBE) operator `$orderby` is described. It sorts query results in ascending or descending order.
- [SODA Paths \(Reference\)](#)  
SODA filter specifications contain paths, each of which targets a value in a JavaScript Object Notation (JSON) document. A path is composed of a series of steps. A detailed definition of SODA paths is presented.
- [SODA Index Specifications \(Reference\)](#)  
You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

## 5.2 Filter Conditions (Reference)

A filter condition can be used either on its own, as a filter specification, or at a lower level, in the query clause of a composite filter specification.

A **filter condition** is a JSON object whose members form one or more of these clauses:

- scalar-equality clause
- field-condition clause
- logical combining clause
- nested-condition clause
- ID clause

- special-criterion clause

A filter condition is true if and only if all of its clauses are true. A filter condition can be *empty* (the empty object, `{}`), in which case all of its (zero) clauses are vacuously true (the filter condition is satisfied).

For example, if a QBE involves only one filter condition and it is empty then all documents of the collection are selected. In this case, a find operation returns all of the documents, and a remove operation removes them all.

- [Scalar-Equality Clause \(Reference\)](#)  
A **scalar-equality clause** tests whether a given object field is equal to a given scalar value.
- [Field-Condition Clause \(Reference\)](#)  
A field-condition clause specifies that a given object field must satisfy a given set of criteria. It constrains a field using one or more condition-operator clauses, each of which is a comparison clause, a not clause, or an item-method clause.
- [Logical Combining Clause \(Reference\)](#)  
A logical combining clause combines the effects of multiple non-empty filter conditions.
- [Nested-Condition Clause \(Reference\)](#)  
A **nested-condition clause** consists of a parent field followed by a single, non-empty filter condition. All fields contained in this **nested condition** are scoped to the parent field.
- [ID Clause \(Reference\)](#)  
Other query-by-example (QBE) operators generally look for particular JSON fields within the content of documents and try to match their values. An **ID clause**, which uses operator `$id`, instead matches document *keys*. It thus matches document *metadata*, not document content.
- [Special-Criterion Clause \(Reference\)](#)  
A special criterion clause is a *contains* clause (operator `$contains`) or a *spatial* clause (operator `$near`, `$intersects`, or `$within`).

## 5.2.1 Scalar-Equality Clause (Reference)

A **scalar-equality clause** tests whether a given object field is equal to a given scalar value.

A scalar-equality clause is an object member with a scalar value. It tests whether the value of the field is equal to the scalar.

*field* : *scalar*

(Reminder: a JSON **scalar** is a value other than an object or an array; that is, it is a JSON number, string, `true`, `false`, or `null`.)

A scalar-equality clause is equivalent in behavior to a field-condition clause with a comparison clause that tests the same field value using operator `$eq`. That is, *field* : *scalar* is equivalent to *field* : { "\$eq" : *scalar* }.

Though the behavior is equivalent, a scalar-equality clause cannot be used in some contexts where the corresponding `"$eq" : field` member can be used. For example,

a scalar-equality clause cannot be used in a not clause. The array elements in the argument array of a not clause must be comparison clauses.

## 5.2.2 Field-Condition Clause (Reference)

A field-condition clause specifies that a given object field must satisfy a given set of criteria. It constrains a field using one or more condition-operator clauses, each of which is a comparison clause, a not clause, or an item-method clause.

A **field-condition clause** is JSON-object member whose field is not an operator and whose value is an object with one or more members, each of which is a *condition-operator clause*:

```
field : { condition-operator-clause ... }
```

A field-condition clause tests whether the field satisfies all of the condition-operator clauses, which are thus implicitly ANDed.

A **condition-operator clause** is any of these:

- A comparison clause
- A not clause
- An item-method clause



### Note:

When a path that does not end in an array step uses a comparison clause or a not clause, and the path targets an array, the test applies to *each* element of the array.

For example, the QBE `{"animal" : {"$eq" : "cat"}}` matches the JSON data `{"animal" : ["dog", "cat"]}`, even though "cat" is an array element. The QBE `{"animal" : {"$not" : {"$eq" : "frog"}}` matches the same data, because each of the array elements is tested for equality with "frog" and this test fails.

- [Comparison Clause \(Reference\)](#)  
A **comparison clause** is an object member whose field is a *comparison operator*.  
Example: `"$gt" : 200`.
- [Not Clause \(Reference\)](#)  
A not clause logically negates the truth value of a set of comparison clauses. When any of the comparison clauses is true, the not clause evaluates to false; when all of them are false, the not clause evaluates to true.
- [Item-Method Clause \(Reference\)](#)  
An **item-method clause** is an *item-method equality clause* or an *item-method modifier clause*. It applies an *item method* to the field of the field-condition clause in which it appears, typically to *modify* the field value. It then matches the result against the operand of the item-method.

- [ISO 8601 Date and Time Support](#)  
International Standards Organization (ISO) standard 8601 describes an internationally accepted way to represent dates and times. Oracle Database supports many of the ISO 8601 date and time formats.

#### Related Topics

- [Nested-Condition Clause \(Reference\)](#)  
A **nested-condition clause** consists of a parent field followed by a single, non-empty filter condition. All fields contained in this **nested condition** are scoped to the parent field.
- [Composite Filters \(Reference\)](#)  
A composite filter specification (query-by-example, or QBE) can appear only at the top level. That is, you cannot nest a composite filter inside another composite filter or inside a filter condition.
- [Sample JSON Documents](#)  
A few sample JSON documents are presented here. They are referenced in some query-by-example (QBE) examples, as well as in some reference descriptions.

### 5.2.2.1 Comparison Clause (Reference)

A **comparison clause** is an object member whose field is a *comparison operator*.

Example: "\$gt" : 200.

[Table 5-1](#) describes the **comparison operators**. See [Sample JSON Documents](#) for the documents used in the examples in column Description.

**Table 5-1 Query-By-Example (QBE) Comparison Operators**

Operator	Description
\$exists	<p>Tests whether the field exists. Matches document if <i>either</i>:</p> <ul style="list-style-type: none"> <li>• The field exists and the operand represents <i>true</i>, meaning that it is any scalar value <i>except</i> false, null, or 0.</li> <li>• The field does not exist and the operand represents <i>false</i>, meaning that it is false, null, or 0.</li> </ul> <p><b>Operand</b> JSON scalar.</p> <p><b>Example</b></p> <pre>{drinks : { "\$exists" : true }}</pre> <p>matches sample document 3.</p> <pre>{drinks : { "\$exists" : false }}</pre> <p>matches sample documents 1 and 2.</p>

Table 5-1 (Cont.) Query-By-Example (QBE) Comparison Operators

Operator	Description
<b>\$eq</b>	Matches document only if field value equals operand value. <b>Operand</b> JSON scalar. <b>Example</b> <pre>{ "name" : { "\$eq" : "Jason" } }</pre> matches sample document 1.
<b>\$ne</b>	Matches document only if field value does not equal operand value or there is no such field in the document. <b>Operand</b> JSON scalar. <b>Example</b> <pre>{ "name" : { "\$ne" : "Jason" } }</pre> matches sample documents 2 and 3.
<b>\$gt</b>	Matches document only if field value is greater than operand value. <b>Operand</b> JSON number or string. <b>Example</b> <pre>{ "age" : { "\$gt" : 50 } }</pre> matches sample document 2.
<b>\$lt</b>	Matches document only if field value is less than operand value. <b>Operand</b> JSON number or string. <b>Example</b> <pre>{ "age" : { "\$lt" : 50 } }</pre> matches sample document 1.
<b>\$gte</b>	Matches document only if field value is greater than or equal to operand value. <b>Operand</b> JSON number or string. <b>Example</b> <pre>{ "age" : { "\$gte" : 45 } }</pre> matches sample documents 1, 2, and 3.

Table 5-1 (Cont.) Query-By-Example (QBE) Comparison Operators

Operator	Description
<b>\$lte</b>	<p>Matches document only if field value is less than or equal to operand value.</p> <p><b>Operand</b> JSON number or string.</p> <p><b>Example</b></p> <pre>{ "age" : { "\$lte" : 45 } }</pre> <p>matches sample document 1.</p>
<b>\$between</b>	<p>Matches document only if string or number field value is between the two operand array elements or equal to one of them.</p> <p><b>Operand</b> JSON array of two scalar elements. The first must be the smaller of the two. (For string values, smaller means first, lexicographically.) At most one of the elements can be <code>null</code>, which means no limit. An error is raised if both are <code>null</code> or if there are not exactly two array elements.</p> <p><b>Example</b></p> <pre>{ "age" : { "\$between" : [49, 70] } }</pre> <p>matches sample documents 2 and 3.</p> <pre>{ "age" : { "\$between" : [45, null] } }</pre> <p>matches sample documents 1, 2, and 3. It is equivalent to</p> <pre>{ "age" : { "\$gte" : 45 } }</pre>
<b>\$startsWith</b>	<p>Matches document only if field value starts with operand value.</p> <p><b>Operand</b> JSON string.</p> <p><b>Example</b></p> <pre>{ "name" : { "\$startsWith" : "J" } }</pre> <p>matches sample document 1.</p>
<b>\$hasSubstring</b> or <b>\$instr</b>	<p>Matches document only if field value is a string with a substring equal to the operand.</p> <p><b>Operand</b> Non-empty JSON string.</p> <p><b>Example</b></p> <pre>{ "street" : { "\$hasSubstring" : "street" } }</pre> <p>matches sample documents 1 and 2.</p>

Table 5-1 (Cont.) Query-By-Example (QBE) Comparison Operators

Operator	Description
<b>\$regex</b>	<p>Matches document only if field value matches operand regular expression.</p> <p><b>Operand</b> SQL regular expression, as a JSON string. See <i>Oracle Database SQL Language Reference</i>.</p> <p><b>Example</b></p> <pre>{"name" : { "\$regex" : ".*son"}}</pre> <p>matches sample document 1.</p>
<b>\$like</b>	<p>Matches document only if field value matches operand pattern.</p> <p><b>Operand</b> SQL LIKE condition pattern, as a JSON string. See <i>Oracle Database SQL Language Reference</i>.</p> <p><b>Example</b></p> <pre>{"city" : { "\$like" : "Mar_"}}</pre> <p>matches sample documents 2 and 3.</p>
<b>\$in</b>	<p>Matches document only if field exists and its value equals at least one value in the operand array.</p> <p><b>Operand</b> Non-empty JSON array of scalars.<sup>1</sup></p> <p><b>Example</b></p> <pre>{"address.zip" : { "\$in" : [ 94088, 90001 ] }}</pre> <p>matches sample documents 1 and 2.</p>
<b>\$nin</b>	<p>Matches document only if one of these is true:</p> <ul style="list-style-type: none"><li>• Field exists, but its value is not equal to any value in the operand array.</li><li>• Field does not exist.</li></ul> <p><b>Operand</b> Non-empty JSON array of scalars.<sup>1</sup></p> <p><b>Example</b></p> <pre>{"address.zip" : { "\$nin" : [ 90001 ] }}</pre> <p>matches sample documents 1 and 2.</p>



Table 5-1 (Cont.) Query-By-Example (QBE) Comparison Operators

Operator	Description
\$all	<p>Matches document only if one of these is true:</p> <ul style="list-style-type: none"> <li>Field value is an array that contains all values in the operand array.</li> <li>Field value is a scalar value and the operand array contains a single matching value.</li> </ul> <p><b>Operand</b> Non-empty JSON array of scalars.<sup>1</sup></p> <p><b>Example</b></p> <pre>{"drinks" : { "\$all" : ["soda", "tea"]}}</pre> <p>matches sample document 2.</p> <pre>{"drinks": { "\$all" : ["tea"]}}</pre> <p>matches sample documents 1 and 2.</p>

<sup>1</sup> A syntax error is raised if the array does not contain at least one element.

### Related Topics

- [Overview of QBE Comparison Operators](#)  
A query-by-example (QBE) comparison operator tests whether a given JSON object field satisfies some conditions.

## 5.2.2.2 Not Clause (Reference)

A not clause logically negates the truth value of a set of comparison clauses. When any of the comparison clauses is true, the not clause evaluates to false; when all of them are false, the not clause evaluates to true.

A **not clause** is an object member whose field is operator `$not` and whose value is an object whose members are comparison clauses, which are implicitly ANDed before negating the truth value of that conjunction.

```
"$not" : { comparison-clause ... }
```

Example: `"$not" : {"$eq" : 200, "$lt" : 40}`.

The following field-condition clause matches documents that have *no* field `address.zip`, as well as documents that have such a field but whose value is a scalar *other than* "90001" or an array that has *no* elements equal to "90001":

```
"address.zip" : {"$not" : {"$eq" : "90001"}}
```

In contrast, the following field-condition clause has the complementary effect: it matches documents that have a field `address.zip` whose value is either the scalar "90001" or an array that contains that scalar value.

```
"address.zip" : { "$eq" : "90001" }
```

Here is an example of a field-condition clause with field `salary` and with value a `not` clause whose operand object has more than one comparison clause. It matches salary values that are **not** both greater than 20,000 *and* less than 100,000. That is, it matches salary values that are either less than or equal to 20,000 *or* greater than or equal to 100,000.

```
"salary" : { "$not" : { "$gt":20000, "$lt":100000} }
```

### Related Topics

- [Overview of QBE Operator \\$not](#)  
Query-by-example (QBE) operator `$not` negates the behavior of its operand, which is a JSON object containing one or more comparison clauses, which are implicitly ANDed.

## 5.2.2.3 Item-Method Clause (Reference)

An **item-method clause** is an *item-method equality clause* or an *item-method modifier clause*. It applies an *item method* to the field of the field-condition clause in which it appears, typically to *modify* the field value. It then matches the result against the operand of the item-method.

For example, item-method operator `$timestamp` *interprets as a time stamp* a string-valued field that is in one of the supported ISO 8601 date formats. After the operator is applied to the value of the targeted field, other processing takes place, including the evaluation of any *not* clause and comparison clauses that make up the item-method modifier clause. The QBE uses the modified data in place of the raw field data that is in your JSON documents.

In some cases, the application of an item-method operator acts only as a *filter*, removing targeted data from the QBE result set. For example, if item-method `$timestamp` is applied to a string value that is *not* in one of the supported ISO 8601 date formats then there is *no match* — the query treats that field occurrence as if it were not present in the document.

 **Note:**

An item-method field (operator) does not, itself, use or act on its associated value (its operand). Instead, it acts on the value of the JSON data that *matches its parent field*.

For example, in the QBE {"birthday" : {"\$date" : {"\$gt" : "2000-01-01"}}}, item-method operator `$date` acts on the JSON data that matches its parent field, `birthday`. It does not use or act on its operand, which is the JSON object (a comparison clause in this case) {"\$gt" : "2000-01-01"}. The `birthday` data (a JSON string of format ISO 8601) in your JSON document is interpreted as a date, and that date is then matched against the condition that it be greater than the date represented by the (ISO date) string "2000-01-01" (later than January 1, 2000).

This can take some getting used to. The operand is used after the item-method operator does its job. It is matched against the *result of the action* of the operator on the value of its *parent* field. A item-method operator is a *filter* of sorts — it stands syntactically *between* the field (to its left) that matches the data it acts on and (to its right) some tests that are applied to the result of that action.

### Item-Method Equality Clause

An **item-method equality clause** is an object member whose field is an *item-method operator* and whose value is a JSON scalar.<sup>6</sup>

```
item-method-operator : scalar
```

The clause first applies the item method to the field of the field-condition clause. It then tests whether the result is equal to the scalar value (operand).

Example: {"\$upper" : "john"}

(An item-method equality clause is equivalent to an item-method modifier clause (see next) whose field value (operand) is an object with a single comparison clause with comparison operator `$eq`. For example, {"\$upper" : "john"} is equivalent to {"\$upper" : {"\$eq" : "john"}}.)

### Item-Method Modifier Clause

An **item-method modifier clause** is an object member whose field is an *item-method operator* and whose value (operand) is an object whose members are *comparison clauses* or at most **one** *not clause*. The operand of the item-method operator cannot be an empty object.

```
item-method-operator : { comparison-or-not-clause ... }7
```

<sup>6</sup> Reminder: a JSON **scalar** is a value other than an object or an array; that is, it is a JSON number, string, true, false, or null.

<sup>7</sup> At most one *not* clause is allowed in the operand.

The clause first applies the item method to the field of the field-condition clause. It then tests whether the result of that operation satisfies all of the comparison clauses and not clause in its object value.

**Example:** `"$upper" : { "$between" : [ "ALPHA", "LAMBDA" ], "$not" : { "$startsWith" : "BE" } }`

### Item-Method Operators

Here is a brief description of each item-method operator. The *target* of the operator is the data matched by the field of the field-condition clause in which the item-method clause appears — the parent field of the operator. It is *not* the *operand* of the operator.

**Table 5-2 Item-Method Operators**

Operator	Description <sup>1</sup>
<code>\$abs</code>	<p>Absolute value of the targeted JSON number.</p> <p><b>Target of Operator</b> JSON number</p> <p><b>Example</b> <code>{"ordinate" : {"\$abs" : {"\$gt" : 1.0}}}</code> matches a negative or positive ordinate value whose magnitude is greater than 1.0. It matches, for example, <code>-1.3</code> and <code>1.3</code>.</p>
<code>\$boolean</code>	<p>A Boolean interpretation of the targeted JSON value.</p> <p><b>Target of Operator</b> JSON Boolean value (<code>true</code> or <code>false</code>) or a string that when converted to lowercase is either <code>"true"</code> or <code>"false"</code></p> <p><b>Example</b> <code>{"retired" : {"\$boolean" : true}}</code> matches (only) a retired value of <code>true</code> or a string that matches <code>"true"</code> case-insensitively.</p>
<code>\$ceiling</code>	<p>The targeted JSON number, rounded up to the nearest integer.</p> <p><b>Target of Operator</b> JSON number</p> <p><b>Example</b> <code>{"age" : {"\$ceiling" : {"\$lt" : 65}}}</code> matches an age value of <code>63.9</code>. It does not match a value of <code>64.1</code>, because <code>64.1</code> rounds up to <code>65</code>.</p>
<code>\$date</code> <sup>2</sup>	<p>A date interpretation of the targeted JSON string.</p> <p><b>Target of Operator</b> JSON string in supported ISO 8601 format</p> <p><b>Example</b> <code>{"birthday" : {"\$date" : "2018-06-30"}}</code> matches a <code>"birthday"</code> value of <code>"2018-06-30"</code> or <code>"2018-06-30T17:29:08Z"</code>, because they are supported ISO 8601 formats for the same date.</p>

Table 5-2 (Cont.) Item-Method Operators

Operator	Description
<b>\$double</b>	<p>A SQL BINARY_DOUBLE interpretation of the targeted JSON number or numeric string value.</p> <p><b>Target of Operator</b> JSON number or numeric string</p> <p><b>Example</b> { "thickness" : { "\$double" : { "\$lt" : 1.0 } } } matches a thickness value of "0.999999999".</p>
<b>\$floor</b>	<p>The targeted JSON number, rounded down to the nearest integer.</p> <p><b>Target of Operator</b> JSON number</p> <p><b>Example</b> { "age" : { "\$floor" : { "\$le" : 65 } } } matches an age value of 65.2. It does not match a value of 66.3, because 66.3 rounds down to 66.</p>
<b>\$length</b>	<p>The number of characters in the targeted JSON string.</p> <p><b>Target of Operator</b> JSON string</p> <p><b>Example</b> { "name" : { "\$length" : { "\$gt" : 4 } } } matches "Jason". It does not match "Mary" because that string has only 4 characters.</p>
<b>\$lower</b>	<p>The lowercase string that corresponds to the characters in the targeted JSON string.</p> <p><b>Target of Operator</b> JSON string</p> <p><b>Example</b> { "name" : { "\$lower" : "mary" } } matches "Mary".</p>
<b>\$number</b>	<p>A SQL NUMBER interpretation of the targeted JSON number or numeric string value. Using \$number is equivalent to specifying a numeric constant.</p> <p><b>Target of Operator</b> JSON number or numeric string</p> <p><b>Example</b> { "thickness" : { "\$number" : { "\$lt" : 1.0 } } } matches a thickness value of "0.9999". { "thickness" : { "\$number" : { "\$lt" : 1.0 } } } is equivalent to { "thickness" : { "\$lt" : 1.0 } }.</p>
<b>\$size</b>	<p>The number of elements in an array, or 1 for a scalar or an object.</p> <p><b>Target of Operator</b> JSON value of any kind</p> <p><b>Example</b> { "drinks" : { "\$size" : { "\$gt" : 1 } } } matches a drinks value of [ "soda", "coffee" ] because the value is an array with more than one element. { "address" : { "\$size" : 1 } } matches an address value that is a JSON object.</p>

Table 5-2 (Cont.) Item-Method Operators

Operator	Description <sup>1</sup>
<b>\$string</b>	<p>A SQL VARCHAR2(4000) interpretation of the targeted JSON scalar. Using \$string is equivalent to specifying a string constant (literal).</p> <p><b>Target of Operator</b> JSON scalar other than null</p> <p><b>Example</b> {"age" : {"\$string" : {"\$lt" : "45"}}} matches a numeric age value of 100, because the string "100" is lexicographically less than the string "45". {"age" : {"\$string" : {"\$lt" : "45"}}} is equivalent to {"age" : {"\$lt" : "45"}}.</p>
<b>\$timestamp<sup>3</sup></b>	<p>A date-with-time interpretation of the targeted JSON string.</p> <p><b>Target of Operator</b> JSON string in supported ISO 8601 format</p> <p><b>Example</b> {"meeting-time" : {"\$timestamp" : VALUE}}, where VALUE is any of the following, matches any of the same values:</p> <ul style="list-style-type: none"> <li>• "2016-07-26T02:06:01Z"</li> <li>• "2016-07-26T02:06:01" (UTC by default)</li> <li>• "2016-07-26T01:06:01-01:00" (1:00 am in a time zone that is one hour behind UTC is equivalent to 2:00 am UTC.)</li> </ul> <p>If VALUE is a date-only ISO 8601 string then its equivalent date-with-time value is used. For example, a date value of "2016-07-26" is treated as the date-with-time zone value "2016-07-26T00:00:00Z".</p>
<b>\$type</b>	<p>The name of the JSON data type of the targeted data, as a lowercase JSON string.</p> <ul style="list-style-type: none"> <li>• "null" for a value of null.</li> <li>• "boolean" for a value of true or false.</li> <li>• "number" for a number.</li> <li>• "string" for a string.</li> <li>• "array" for an array.</li> <li>• "object" for an object.</li> </ul> <p><b>Target of Operator</b> JSON value of any kind</p> <p><b>Example</b> {"address" : {"\$type" : "object"}} matches an address value that is a JSON object.</p>
<b>\$upper</b>	<p>The uppercase string that corresponds to the characters in the targeted JSON string.</p> <p><b>Target of Operator</b> JSON string</p> <p><b>Example</b> {"name" : {"\$upper" : "MARY"}} matches "Mary".</p>

<sup>1</sup> The scalar-equality abbreviation {*field* : {*operator* : *value*}} is used everywhere in examples here, in place of the equivalent {*field* : {*operator* : {"\$eq" : *value*}}}.

<sup>2</sup> The operand of operator \$date must be a JSON string that has a supported ISO 8601 format. Otherwise, no match is found.

- <sup>3</sup> The operand of operator `$timestamp` must be a JSON string that has a supported ISO 8601 format. Otherwise, no match is found.

 **Note:**

- If an item-method conversion fails for any reason, such as the operand being of the wrong type, then the path cannot be matched (it refers to no data), and no error is raised.
- If an item-method operator is applied to an *array* then it is in effect applied to each of the array elements.

For example, QBE `{"color" : {"$upper" : "RED"}}` matches data `{"color" : ["Red", "Blue"]}` because the array has an element that when converted to uppercase matches "RED". The QBE is equivalent to `{"color[*]" : {"$upper" : "RED"}}` — operator `$upper` is applied to each array element of the target data.

 **Note:**

- To use item method operator `$abs`, `$date`, `$size`, `$timestamp`, or `$type` you need Oracle Database Release 18c or later.
- To use any other item method you need Oracle Database Release 12c (12.2.0.1) or later.

**Related Topics**

- [Overview of QBE Item-Method Operators](#)

A query-by-example (QBE) item-method operator acts on a JSON-object field value to modify or transform it in some way (or simply to filter it from the query result set). Other QBE operators that would otherwise act on the field value then act on the transformed field value instead.

- [SODA Index Specifications \(Reference\)](#)

You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

- [ISO 8601 Date and Time Support](#)

International Standards Organization (ISO) standard 8601 describes an internationally accepted way to represent dates and times. Oracle Database supports many of the ISO 8601 date and time formats.

 **See Also:**

*Oracle Database JSON Developer's Guide*

## 5.2.2.4 ISO 8601 Date and Time Support

International Standards Organization (ISO) standard 8601 describes an internationally accepted way to represent dates and times. Oracle Database supports many of the ISO 8601 date and time formats.

International Standards Organization (ISO) standard 8601 describes an internationally accepted way to represent dates and times. You can manipulate strings that are in the most common ISO 8601 date and time formats as proper Oracle Database date and time values. The ISO 8601 formats that are supported are essentially those that are numeric-only, language-neutral, and unambiguous.

This is the allowed syntax for dates and times:

- Date (only): `YYYY-MM-DD`
- Date with time: `YYYY-MM-DDThh:mm:ss[.s[s[s[s[s]]]]][Z|(+|-)hh:mm]`

where:

- `YYYY` specifies the *year*, as four decimal digits.
- `MM` specifies the *month*, as two decimal digits, 00 to 12.
- `DD` specifies the *day*, as two decimal digits, 00 to 31.
- `hh` specifies the *hour*, as two decimal digits, 00 to 23.
- `mm` specifies the *minutes*, as two decimal digits, 00 to 59.
- `ss[.s[s[s[s[s]]]]]` specifies the *seconds*, as two decimal digits, 00 to 59, optionally followed by a decimal point and 1 to 6 decimal digits (representing the fractional part of a second).
- `z` specifies *UTC* time (time zone 0). (It can also be specified by `+00:00`, but not by `-00:00`.)
- `(+|-)hh:mm` specifies the time-zone as *difference from UTC*. (One of `+` or `-` is required.)

For a time value, the time-zone part is optional. If it is absent then UTC time is assumed.

No other ISO 8601 date-time syntax is supported. In particular:

- Negative dates (dates prior to year 1 BCE), which begin with a hyphen (e.g. `-2018-10-26T21:32:52`), are not supported.
- Hyphen and colon separators are required: so-called “basic” format, `YYYYMMDDThmmss`, is not supported.
- Ordinal dates (year plus day of year, calendar week plus day number) are not supported.
- Using more than four digits for the year is not supported.

Supported dates and times include the following:

- `2018-10-26T21:32:52`
- `2018-10-26T21:32:52+02:00`
- `2018-10-26T19:32:52Z`



- 2018-10-26T19:32:52+00:00
- 2018-10-26T21:32:52.12679

Unsupported dates and times include the following:

- 2018-10-26T21:32 (if a time is specified then all of its parts must be present)
- 2018-10-26T25:32:52+02:00 (the hours part, 25, is out of range)
- 18-10-26T21:32 (the year is not specified fully)

### Related Topics

- [Item-Method Clause \(Reference\)](#)

An **item-method clause** is an *item-method equality clause* or an *item-method modifier clause*. It applies an *item method* to the field of the field-condition clause in which it appears, typically to *modify* the field value. It then matches the result against the operand of the item-method.

#### See Also:

- [ISO 8601 standard](#)
- [ISO 8601 at Wikipedia](#)

## 5.2.3 Logical Combining Clause (Reference)

A logical combining clause combines the effects of multiple non-empty filter conditions.

A **logical combining clause** is a **logical combining operator** — `$and`, `$or`, or `$nor` — followed by a non-empty array of one or more non-empty filter conditions.

This logical combining clause uses operator `$or`. It is satisfied if either of its conditions is true (or if both are true). That is, it is satisfied if the document contains a field `name` whose value is "Joe", or if it contains a field `salary` whose value is 10000.

```
"$or" : [ { "name" : "Joe" }, { "salary" : 10000 } ]
```

The following logical combining clause uses operator `$and`. Its array operand has two filter conditions as its members. The second of these is a condition with a logical combining clause that uses operator `$or`. This logical combining clause is satisfied if both of its conditions are true. That is, it is satisfied if the document contains a field `age` whose value is at least 60, *and either* it contains a field `name` whose value is "Jason" *or* it contains a field `drinks` whose value is "tea".

```
"$and" : [ { "age" : { "$gte" : 60 } },
           { "$or" : [ { "name" : "Jason" }, { "drinks" : "tea" } ] } ]
```

- [Omitting \\$and](#)  
Sometimes you can omit the use of `$and`.

<sup>8</sup> A syntax error is raised if the array does not contain at least one element.

### 5.2.3.1 Omitting \$and

Sometimes you can omit the use of \$and.

A filter condition is true if and only if *all* of its clauses are true. And a field-condition clause can contain multiple condition clauses, *all* of which must be true for the field-condition clause as whole to be true. In each of these, logical conjunction (AND) is implied. Because of this you can often omit the use of \$and, for brevity.

This is illustrated by [Example 5-1](#) and [Example 5-2](#), which are equivalent in their effect. Operator \$and is explicit in [Example 5-1](#) and implicit (omitted) in [Example 5-2](#).

The filter specifies objects for which the name starts with "Fred" *and* the salary is greater than 10,000 and less than or equal to 20,000 *and* either address.city is "Bedrock" or address.zip is 12345 *and* married is true.

A rule of thumb for \$and omission is this: If you omit \$and, make sure that no field or operator in the resulting filter appears multiple times at the same level in the same object.

This rule precludes using a QBE such as this, where field salary appears twice at the same level in the same object:

```
{ "salary" : { "$gt" : 10000 },
  "age"     : { "$gt" : 40 },
  "salary" : { "$lt" : 20000 } }
```

And it precludes using a QBE such as this, where the same condition operator, \$regex, is applied more than once to field name in the same condition clause:

```
{ "name" : { "$regex" : "son", "$regex" : "Jas" } }
```

The behavior here is *not* that the field condition is true if and only if both of the \$regex criteria are true. To be sure to get that effect, you would use a QBE such as this one:

```
{ $and : [ { "name" : { "$regex" : "son" } }, { "name" : { "$regex" :
"Jas" } } ] }
```

If you do not follow the rule of thumb for \$and omission then *only one* of the conflicting condition clauses that use the same field or operator is evaluated; the others are ignored, and no error is raised. For the salary example, only one of the salary field-condition clauses is evaluated; for the name example, only one of the \$regex condition clauses is evaluated. Which one of the set of multiple condition clauses gets evaluated is undefined.

#### Example 5-1 Filter Specification with Explicit \$and Operator

```
{ "$and" : [ { "name" : { "$startsWith" : "Fred" } },
  { "salary" : { "$gt" : 10000, "$lte" : 20000 } },
  { "$or" : [ { "address.city" : "Bedrock" },
    { "address.zip" : 12345 } ] },
  { "married" : true } ] }
```

**Example 5-2 Filter Specification with Implicit \$and Operator**

```
{ "name"      : { "$startsWith" : "Fred" },
  "salary"   : { "$gt"   : 10000, "$lte" : 20000 },
  "$or"      : [ { "address.city"   : "Bedrock" },
                  { "address.zip"   : 12345 } ],
  "married"  : true }
```

## 5.2.4 Nested-Condition Clause (Reference)

A **nested-condition clause** consists of a parent field followed by a single, non-empty filter condition. All fields contained in this **nested condition** are scoped to the parent field.

*parent\_field* : *filter-condition*

**Note:**

Since the condition of a nested-condition clause follows a field, it *cannot contain* an ID clause or a special-criterion clause. Those clauses can occur only at root level.

For example, suppose that field `address` has child fields `city` and `state`. The following nested-condition clause tests whether field `address.city` has the value "Boston" and field `address.state` has the value "MA":

```
"address" : { "city" : "Boston", "state" : "MA" }
```

Similarly, this nested-condition clause tests whether the value of `address.city` starts with `Bos` and `address.state` has the value "MA":

```
"address" : { "city" : { "$startsWith" : "Bos" }, "state" : "MA" }
```

Suppose that you have this document:

```
{ "address" : [ { "city" : "Boston", "state" : "MA" },
                 { "city" : "Los Angeles", "state" : "CA" } ] }
```

The following query matches each path in the document *independently*. Each object element of an `address` array is matched independently to see if it has a city value of "Boston" *or* a state value of "CA".

```
{ "address.city" : "Boston", "address.state" : "CA" }
```

This query without a nested condition thus matches the preceding document, which has no *single object with both* city "Boston" and state "CA".

The following query, with a nested-condition clause for parent field `address`, does *not* match the preceding document, because that document has no single object in an `address` array with both a field `city` of value "Boston" and a field `state` of value "CA".

```
{ "address" : { "city" : "Boston", "state" : "CA" } }
```

### Related Topics

- [Overview of Nested Conditions in QBEs](#)  
You can use a query-by-example (QBE) with a *nested* condition to match a document that has a field with an *array* value with object elements, where a *given element of the array satisfies multiple criteria*.
- [Special-Criterion Clause \(Reference\)](#)  
A special criterion clause is a *contains* clause (operator `$contains`) or a *spatial* clause (operator `$near`, `$intersects`, or `$within`).

## 5.2.5 ID Clause (Reference)

Other query-by-example (QBE) operators generally look for particular JSON fields within the content of documents and try to match their values. An **ID clause**, which uses operator `$id`, instead matches document *keys*. It thus matches document *metadata*, not document content.

A document key uniquely identifies a given document. It is metadata, like the creation time stamp, last-modified time stamp, and version. It pertains to the document as a whole and is not part of the document content.

The syntax of an ID clause is QBE operator `$id` followed by either a scalar key (document identifier) or a non-empty array of scalar keys.<sup>12</sup> The scalar key must be either an integer or a string. The array elements must be either all integers or all strings. For example:

```
"$id" : "USA"  
"$id" : [1001,1002,1003]
```

Like a special-criterion clause, you can use operator `$id` only in the outermost condition of a QBE, that is, in a condition used in a composite filter or in a filter-condition filter. More precisely, if a QBE also uses other operators, in addition to `$id`, then the outermost condition must have operator `$and`, and the *sole* occurrence of a `$id` condition must be an element of the array argument to that `$and` occurrence.

[Example 5-3](#) illustrates this. It finds documents that have at least one of the keys `key1` and `key2` and that have a `color` field with value "red".

### Example 5-3 Use of Operator `$id` in the Outermost QBE Condition

```
{ "$and" : [ { $id : [ "key1", "key2" ] }, { "color" : "red" } ] }
```

### Related Topics

- [Overview of QBE Operator `\$id`](#)  
Other query-by-example (QBE) operators generally look for particular JSON fields within documents and try to match their values. Operator `$id` is an exception in

that it instead matches document *keys*. It thus matches document *metadata*, not document content. You use operator `$id` in the outermost condition of a QBE.

- [Special-Criterion Clause \(Reference\)](#)  
A special criterion clause is a *contains* clause (operator `$contains`) or a *spatial* clause (operator `$near`, `$intersects`, or `$within`).

## 5.2.6 Special-Criterion Clause (Reference)

A special criterion clause is a *contains* clause (operator `$contains`) or a *spatial* clause (operator `$near`, `$intersects`, or `$within`).

Like an ID clause, you can use a special-criterion clause only in the outermost condition of a QBE, that is, in a condition used in a composite filter or in a filter-condition filter. More precisely, if a QBE also uses other operators, in addition to the operators for a special-criterion clause, then the outermost condition must have operator `$and`, and the special-criterion clauses must be elements of the array argument to that `$and` occurrence.

- [Contains Clause \(Reference\)](#)  
A contains clause is a field followed by an object with one `$contains` operator, whose value is a string. It matches a document only if a string or number in the field value matches the string operand somewhere, including in array elements. Matching is Oracle Text full-text.
- [Spatial Clause \(Reference\)](#)  
GeoJSON objects are JSON objects that represent geographic data. You can use a SODA QBE spatial clause to match GeoJSON geometry objects in your documents.

### Related Topics

- [ID Clause \(Reference\)](#)  
Other query-by-example (QBE) operators generally look for particular JSON fields within the content of documents and try to match their values. An **ID clause**, which uses operator `$id`, instead matches document *keys*. It thus matches document *metadata*, not document content.

### 5.2.6.1 Contains Clause (Reference)

A contains clause is a field followed by an object with one `$contains` operator, whose value is a string. It matches a document only if a string or number in the field value matches the string operand somewhere, including in array elements. Matching is Oracle Text full-text.

For example, `$contains` operand "beth" matches the string "Beth Smith", but not the string "Elizabeth Smith". Operand "10" matches the number 10 or the string "10 Main Street", but not the number 110 or the string "102 Main Street".

#### Note:

To use operator `$contains` you need Oracle Database Release 12c (12.2.0.1) or later.

Oracle Text technology underlies SODA QBE operator `$contains`. This means, for instance, that you can query for text that is near some other text, or query use fuzzy pattern-matching.

For details about the behavior of a SODA QBE contains clause see the Oracle Database documentation for SQL condition `json_textcontains`.

To be able to use operator `$contains` you first must create a JSON search index; otherwise, a QBE with `$contains` raises a SQL error.

You can use a contains clause only in the outermost condition of a QBE. You can have multiple contains clauses at the top level, provided their fields are different (objects in QBEs must not have duplicate fields). For example, this QBE checks for a "name" field that contains the word "beth" and an "address" field that contains the number 10 or the string "10" as a word:

```
{ "name"      : { "$contains" : "beth" }
  "address"  : { "$contains" : "10" } }
```

To have the effect of multiple contains clauses for the *same* field (search the same field for multiple word or number patterns), the outermost condition must have operator `$and`, and the contains clauses must occur in object elements of the array argument to that `$and` occurrence.

For example, this QBE checks for an "address" field that contains *both* the word "street" *and* either the number 10 or the word "10":

```
{"$and" : [ { "address" : { "$contains" : "street" } ,
             { "address" : { "$contains" : "10" } } } ] }
```

## Related Topics

- [Logical Combining Clause \(Reference\)](#)  
A logical combining clause combines the effects of multiple non-empty filter conditions.
- [Overview of SODA Indexing](#)  
The performance of SODA QBEs can sometimes be improved by using indexes. You define a SODA index with an index specification, which is a JSON object that specifies how particular QBE patterns are to be indexed for quicker matching.
- [SODA Index Specifications \(Reference\)](#)  
You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

### See Also:

- *Oracle Database SQL Language Reference* for reference information about SQL condition `json_textcontains`
- *Oracle Database JSON Developer's Guide* for information about full-text search of JSON documents using SQL condition `json_textcontains`

## 5.2.6.2 Spatial Clause (Reference)

GeoJSON objects are JSON objects that represent geographic data. You can use a SODA QBE spatial clause to match GeoJSON geometry objects in your documents.

### Note:

To use QBE spatial operators you need Oracle Database Release 12c (12.2.0.1) or later.

A spatial QBE clause is a field followed by an object with a spatial operator: `$near`, `$intersects`, or `$within`. It matches the field only if it contains GeoJSON geographic data that is *near* a specified position, *intersects* a specified geometric object, or is *within* a specified geometric object, respectively.

Each of the spatial QBE operators is followed by a JSON object whose fields must include `$geometry`. Operator `$near` must also include field `$distance`, and it can include `$unit`. A compile-time error is raised if `$geometry` is missing or if `$distance` or `$unit` is present with operator `$intersects` or `$within`.

The value of field `$geometry` is interpreted as a GeoJSON geometry object (other than a geometry collection), such as a point or a polygon. Each such object has a `type` field, with the geometry type, such as "Point" or "Polygon" as value, and a `coordinates` field, which defines the shape and location of the object, respectively.

(For a single position, such as an object of type "Point", field `coordinates` is an array of numbers, the first three of which generally represent longitude, latitude, and altitude, in that order.)

The value of field `$distance` must be a positive number, the distance from the field preceding spatial operator `$near` to the geometry object specified by `$geometry`. For non-point geometry objects, such as lines and polygons, the distance is the minimum distance between them. The distance between two adjacent polygons is zero.

The value of field `$unit` is a string such as "mile" that specifies the GeoJSON unit to use for the `$distance` value. The available units are defined in database table `SDO_UNITS_OF_MEASURE`. The default unit is "mile".

### Example 5-4 QBE With a Spatial Clause

This example matches a `location` field whose value is GeoJSON geometry object of type `Point`, and which is within 60 miles of the coordinates `[-122.417, 37.783]` (San Francisco, California). It would match data with a "location" value of `[-122.236, 37.483]` (Redwood City, California). (Note that the first element of array "coordinates" is the *longitude*, and the second is the *latitude*.)

```
{ "location" : { "$near" : { "$geometry" : { "type" : "Point",
                                           "coordinates" : [-122.417,
37.783] },
                    "$distance" : 60,
                    "$unit" : "mile" } } }
```

The default error-handling behavior for a QBE spatial clause is that the targeted field need not be present, but if it is present then its value must be a single GeoJSON `geometry` object. An error is raised at query time if, for any matching document, that is not the case.<sup>9</sup>

A spatial clause can specify an *alternative error-handling* behavior from the default by including one of the following Boolean fields with a `true` value in the object that a spatial operator (`$near`, `$within`, `$intersects`) applies to. (*Only one* of these error-handling fields can be specified as `true`; otherwise, a syntax error is raised at query time.)

- **`$scalarRequired`** — Boolean. *Optional*. The targeted field *must* be present and have a GeoJSON `geometry` object as its value. Raise an error at query time if, for any matched document, that is not the case.
- **`$lax`** — Boolean. *Optional*. The targeted field need *not* be present or have a GeoJSON `geometry` object as its value. Do not raise an error at query time if, for any matched document, that is the case.<sup>11</sup>

#### Note:

If you have created a SODA spatial index, for a field whose value is a GeoJSON `geometry` object, and you use a QBE that targets that field, the index can be picked up for the QBE *only* if both index and QBE specify the *same* error-handling behavior for that field. Both must specify the *same one* of these:

- `scalarRequired : true`
- `lax : true`
- Neither `scalarRequired : true` nor `lax : true`

### Related Topics

- [Overview of QBE Spatial Operators](#)  
You can use query-by-example (QBE) operator `$near`, `$intersects`, or `$within` to select documents that have a field whose value is a GeoJSON `geometry` object that is *near* a specified position, *intersects* a specified geometric object, or is *within* another specified geometric object, respectively.
- [SODA Index Specifications \(Reference\)](#)  
You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

<sup>9</sup> The default error-handling behavior corresponds to the use of SQL clauses `ERROR ON ERROR` and `NULL ON EMPTY` for a `json_value` expression.

<sup>1</sup> A `true` value of `$scalarRequired` corresponds to the use of SQL clause `ERROR ON ERROR` for a `json_value` expression.

<sup>1</sup> A `true` value of `$lax` corresponds to the use of SQL clause `NULL ON ERROR` for a functional index created on a `json_value` expression.



 **See Also:**

- *Oracle Spatial and Graph Developer's Guide* for information about using GeoJSON data with Oracle Spatial and Graph
- *Oracle Spatial and Graph Developer's Guide* for information about Oracle Spatial and Graph and `SDO_GEOMETRY` object type
- [GeoJSON.org](http://GeoJSON.org) for information about GeoJSON
- *The GeoJSON Format Specification* for details about GeoJSON data
- *Oracle Database JSON Developer's Guide* for information about using GeoJSON geographic data with SQL/JSON functions

# 6

## SODA Index Specifications (Reference)

You can index the data in JSON documents using index specifications. A detailed definition of SODA index specifications is presented.

### Note:

- To create a *B-tree index* you need Oracle Database Release 12c (12.2.0.1) or later. To create a B-tree index that indexes a `DATE` or a `TIMESTAMP` value you need Oracle Database Release 18c (18.1) or later.
- To create a *spatial index* or a *search index* you need Oracle Database Release 12c (12.2.0.1) or later.

An **index specification** is a JSON object that specifies a particular kind of database index, which is used for operations on JSON documents. You can specify these kinds of index:

- **B-tree:** Used to index scalar JSON values. It is identified by the presence of field `fields`. (Only a B-tree index has this field.)
- **Spatial:** Used to index GeoJSON geographic data. It is identified by the presence of field `spatial`. (Only a spatial index has this field.)
- **Search:** Used for one or both of the following:
  - Ad hoc structural queries or full-text searches
  - JSON data guide

A search index specification is identified by the *lack* of fields `fields` and `spatial`.

Each kind of index specification requires a **name** field, which is a string that names the index.

### B-Tree Index Specifications

A SODA B-tree index specification specifies a B-tree function-based index on SQL/JSON function `json_value`, which is used by SODA to query JSON documents for scalar values. A B-tree index specification can have the following fields. Field `fields` is required for a B-tree index specification. The other fields are optional.

- **fields** — Array of objects, each of which targets a field in the indexed documents that has a scalar JSON value.

Each object in the array can have the following fields:

- **path** — String specifying the path to the targeted field, whose value is expected to be a scalar. *Required.*

If there are any array steps in the path then only the first element of each such array is used for indexing. In your documents, only scalar values for the

targeted field are handled by the index — any non-scalar values for the field are ignored by the index.

- **datatype** — String naming the data type of the targeted-field value, for indexing purposes. *Optional*. Possible values (all are interpreted case-insensitively): "varchar2" (default), "number", "date", "timestamp", and the "varchar2" synonyms "string" and "varchar".

An index can be used to improve performance when evaluating a QBE filter criterion if the effective type of the input data matched by QBE filter criteria matches the index `datatype` value.

For an index to be picked up, to evaluate a given QBE, it is sufficient that the scalar JSON value targeted by the QBE be interpreted as being of the same SQL data type as the value of index-specification field `datatype`. This is the case for a JSON number value or string value and an index `datatype` of "number" or "varchar2" (or a "varchar2" synonym or no `datatype`), respectively.

For other `datatype` values there is no directly corresponding JSON scalar data type, so for a QBE to pick up the index it needs to use an item-method operator, to transform the JSON value to a SQL value of the appropriate data type.

For example, in a QBE such as `{ "dateField" : { "$date" : "2017-07-25" } }` the input string value "2017-07-25" (which has one of the supported ISO 8601 date formats) is converted by QBE item-method operator `$date` to data type "date". An index specified with a `datatype` value of "date" can be picked up to evaluate the QBE.

A QBE that does not explicitly use item-method operator `$number` or `$string` can pick up an index whose `datatype` is "number" or "varchar2" (or one of its synonyms), respectively, because of the direct correspondence between JSON and SQL data types for such values. For example:

- \* Using QBE `{ "numField" : 20 }`, like using `{ "numField" : { "$number" : 20 } }`, can pick up an index created with `datatype` value "number".
- \* Using QBE `{ "stringField" : "my string" }`, like using `{ "stringField" : { "$string" : "my string" } }`, can pick up an index created with `datatype` value "varchar2" (or one of its synonyms).
- **maxLength** — Number specifying the maximum length of the value to index. *Optional*. Ignored if the `datatype` is one (such as `number`) that has no length. If `maxLength` is not specified then the length of the value indexed is 4000 divided by the number of string fields that are indexed.
- **order** — Index sorting order, for `datatype` `varchar2` (or one of its synonyms) or `number`. *Optional*. The value of field `order` can be the string "asc" or the number 1, meaning ascending order, or the string "desc" or the number -1, meaning descending order. Default: ascending order.

Index sorting order is particularly relevant for a specification that indexes multiple, related fields, that is, where the result is a *composite* B-tree index. The order of the elements in array `fields` specifies the primary indexing order, that is, the order *among* the targeted fields, with the field of the first array element having the highest priority. The value of field `order` specifies the index sorting order for a single targeted field (specified by `path`).

- **unique** — Boolean. *Optional*. Whether the index is unique. Default: nonunique (`false`).
- **indexNulls** — Boolean. *Optional*. Whether to index `NULL` values for the selected columns (by appending the numeric value 1 to the list of columns to index). Default: do not index `NULL` values (`false`).

 **Note:**

You must specify a `true` value for `indexNulls`, for the index to be picked up for the `orderby` clause of a QBE.

The default error-handling behavior is that the targeted field need not be present, but if it is present then its value must be a JSON scalar that is convertible to data type `datatype`. An error is raised at query time if, for any document, that is not the case. In addition, if such an index exists, and you try to write a document where that is not the case, then an error is raised for the write operation.<sup>1</sup>

A B-tree index specification can specify an *alternative error-handling* behavior from the default by including field `scalarRequired` with a `true` value. That requires that the targeted field be present and have a value convertible to data type `datatype`. If, for any document to be indexed, that is not the case then an error is raised at indexing time. In addition, if such an index exists, and you try to write a document where that is not the case, then raise an error for the write operation.<sup>2</sup>

 **Note:**

A JSON `null` value in your data is always convertible to the data type specified for the index. That data is simply not indexed. (This is true regardless of the value of `scalarRequired`.)

### Spatial Index Specifications

A SODA spatial index specification specifies an Oracle Spatial and Graph index, which indexes GeoJSON data. A spatial index specification has a `spatial` field, whose value is a string specifying the path to the JSON field to be indexed. The value of that targeted JSON field is expected to be a single GeoJSON `geometry` object, that is, a JSON scalar that is also a GeoJSON `geometry` object.

The default error-handling behavior is that the targeted field need not be present, but if it is present then its value must be a single GeoJSON `geometry` object. An error is raised at indexing time if, for any document to be indexed, that is not the case. In addition, if such an index exists, and you try to write a document where that is not the case, then an error is raised for the write operation.<sup>3</sup>

<sup>1</sup> The default error-handling behavior corresponds to the use of SQL clauses `ERROR ON ERROR` and `NULL ON EMPTY` for a functional index created on a `json_value` expression.

<sup>2</sup> A `true` value of `scalarRequired` corresponds to the use of SQL clause `ERROR ON ERROR` for a functional index created on a `json_value` expression.

<sup>3</sup> The default error-handling behavior corresponds to the use of SQL clauses `ERROR ON ERROR` and `NULL ON EMPTY` for a functional index created on a `json_value` expression.

A spatial index specification can specify an *alternative error-handling* behavior from the default by including one of the following Boolean fields with a `true` value. (*Only one* of these error-handling fields can be specified as `true`; otherwise, a syntax error is raised at index-creation time.)

- **scalarRequired** — Boolean. *Optional*. The targeted field *must* be present and have a GeoJSON `geometry` object as its value. Raise an error at indexing time if, for any document to be indexed, that is not the case. In addition, if such an index exists, and you try to write a document where that is not the case, then raise an error for the write operation.
- **lax** — Boolean. *Optional*. The targeted field need *not* be present or have a GeoJSON `geometry` object as its value. Do not raise an error at indexing time for any document to be indexed that lacks the field or for which the field value is not geometry. In addition, if such an index exists, and you try to write a document where that is the case, do not raise an error for the write operation.<sup>5</sup>

#### Note:

If you have created a SODA spatial index, for a field whose value is a GeoJSON `geometry` object, and you use a QBE that targets that field, the index can be picked up for the QBE *only* if both index and QBE specify the *same* error-handling behavior for that field. Both must specify the *same one* of these:

- `scalarRequired : true`
- `lax : true`
- Neither `scalarRequired : true` nor `lax : true`

## Search Index Specifications

A SODA search index specification specifies a **JSON search index**, which indexes the textual context of your JSON documents in a general way. A search index can improve the performance of both (1) *ad hoc* structural queries, that is, queries that you might not anticipate or use regularly, and (2) queries that make use of *full-text* search. It is an Oracle Text index that is designed specifically for use with JSON data.

A JSON search index can also accumulate and update aggregate information about your documents. In this it provides a JSON **data guide**, which is a summary of the structural and type information contained in a set of JSON documents. It records metadata about the fields used in those documents.

You can use data-guide information to:

- Generate a JSON Schema document that describes the set of JSON documents.
- Create database views that you can use to perform SQL operations on the data in the documents.

<sup>4</sup> A true value of `scalarRequired` corresponds to the use of SQL clause `ERROR ON ERROR` for a functional index created on a `json_value` expression.

<sup>5</sup> A true value of `lax` corresponds to the use of SQL clause `NULL ON ERROR` for a functional index created on a `json_value` expression.

- Automatically add or update virtual database columns that correspond to added or changed fields in the documents.

The data-guide information contained in a JSON search index is updated automatically as new JSON content is added.

By default, a search index specification creates an index that provides both of these features: a general index and a data guide. These features are specified by fields `search_on` (string) and `dataguide` (string), respectively.

If field `search_on` is present with value `"none"` then the index provides only the data-guide functionality (no general search index). If field `dataguide` is present with value `"off"` then only the general search-index functionality is provided (no data-guide support). (A `dataguide` value of `"on"`, or no field `dataguide`, specifies data-guide support).

Besides `none`, field `search_on` can also have value `"text"` or `"text_value"`. Both of these support full-text queries, which use QBE operator `$contains`, and they both support ad hoc queries that make of other QBE operators, such as `$eq`, `$ne`, and `$gt`.

In addition, `search_on` value `"text_value"` indexes numeric ranges. This is a separate value because it has an added performance cost. If you do not need range indexing then you can save some index maintenance time and some disk space by specifying value `text` instead of `text_value`. The default value of `search_on` is `text_value`.

### Related Topics

- [Overview of SODA Indexing](#)  
The performance of SODA QBEs can sometimes be improved by using indexes. You define a SODA index with an index specification, which is a JSON object that specifies how particular QBE patterns are to be indexed for quicker matching.
- [Item-Method Clause \(Reference\)](#)  
An **item-method clause** is an *item-method equality clause* or an *item-method modifier clause*. It applies an *item method* to the field of the field-condition clause in which it appears, typically to *modify* the field value. It then matches the result against the operand of the item-method.
- [Orderby Clause Sorts Selected Objects](#)  
A filter specification (query-by-example, or QBE) with an orderby clause returns the selected JSON documents in sorted order.

 **See Also:**

- *Oracle Database JSON Developer's Guide* for information about using SQL to create `json_value` B-tree indexes
- *Oracle Database JSON Developer's Guide* for information about using SQL to index multiple JSON fields with a composite `json_value` B-tree index
- *Oracle Database Performance Tuning Guide* and *Oracle Database SQL Language Reference*, section ASC | DESC, for information about indexing order
- *Oracle Database JSON Developer's Guide* for information about the use of a `NULL ON EMPTY` clause for a B-tree index created on a `json_value` expression
- *Oracle Database JSON Developer's Guide* for information about JSON search indexes
- ISO 8601 for information about the ISO date formats
- *Oracle Spatial and Graph Developer's Guide* for information about spatial indexes

# 7

## SODA Collection Metadata Components (Reference)

Collection metadata is composed of multiple components. A detailed definition of the components is presented.

### Note:

The identifiers used for collection metadata components (schema name, table name, view name, database sequence name, and column names) must be valid Oracle quoted identifiers. Some characters and words that are allowed in Oracle quoted identifiers are strongly discouraged. For details, see *Oracle Database SQL Language Reference*.

- **Schema**  
The collection metadata component that specifies the name of the Oracle Database schema that owns the table or view to which the collection is mapped.
- **Table or View**  
The collection metadata component that specifies the name of the table or view to which the collection is mapped.
- **Key Column Name**  
The collection metadata component that specifies the name of the column that stores the document key.
- **Key Column Type**  
The collection metadata component that specifies the SQL data type of the column that stores the document key.
- **Key Column Max Length**  
The collection metadata component that specifies the maximum length of the key column in bytes. This component applies only to keys of type `VARCHAR2`.
- **Key Column Assignment Method**  
The collection metadata component that specifies the method used to assign keys to objects that are inserted into the collection.
- **Key Column Sequence Name**  
The collection metadata component that specifies the name of the database sequence that generates keys for documents that are inserted into a collection if the key assignment method is `SEQUENCE`.
- **Content Column Name**  
The collection metadata component that specifies the name of the column that stores the database content.

<sup>1</sup> Reminder: letter case is significant for a quoted SQL identifier; it is interpreted case-sensitively.



- [Content Column Type](#)  
The collection metadata component that specifies the SQL data type of the column that stores the document content.
- [Content Column Max Length](#)  
The collection metadata component that specifies the maximum length of the content column in bytes. This component applies only to content of type `VARCHAR2`.
- [Content Column JSON Validation](#)  
The collection metadata component that specifies the syntax to which JavaScript Object Notation (JSON) content must conform—strict or lax.
- [Content Column SecureFiles LOB Compression](#)  
The collection metadata component that specifies the SecureFiles LOB compression setting.
- [Content Column SecureFiles LOB Cache](#)  
The collection metadata component that specifies the SecureFiles LOB cache setting.
- [Content Column SecureFiles LOB Encryption](#)  
The collection metadata component that specifies the SecureFiles LOB encryption setting.
- [Version Column Name](#)  
The collection metadata component that specifies the name of the column that stores the document version.
- [Version Column Generation Method](#)  
The collection metadata component that specifies the method used to compute version values for objects when they are inserted into a collection or replaced.
- [Last-Modified Time Stamp Column Name](#)  
The collection metadata component that specifies the name of the column that stores the last-modified time stamp of the document.
- [Last-Modified Column Index Name](#)  
The collection metadata component that specifies the name of the index on the last-modified column.
- [Creation Time Stamp Column Name](#)  
The collection metadata component that specifies the name of the column that stores the creation time stamp of the document. This time stamp is generated during the `insert`, `insertAndGet`, `save`, or `saveAndGet` operation.
- [Media Type Column Name](#)  
The collection metadata component that specifies the name of the column that stores the media type of the document. A media type column is needed if the collection is to be heterogeneous, that is, it can store documents other than JavaScript Object Notation (JSON).
- [Read Only](#)  
The collection metadata component that specifies whether the collection is read-only.

## 7.1 Schema

The collection metadata component that specifies the name of the Oracle Database schema that owns the table or view to which the collection is mapped.

Property	Value
Default value	None
Allowed values	Valid Oracle quoted identifier <sup>1</sup> . If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	schemaName

### See Also:

*Oracle Database SQL Language Reference* for information about valid Oracle quoted identifiers

## 7.2 Table or View

The collection metadata component that specifies the name of the table or view to which the collection is mapped.

Property	Value
Default value	None
Allowed values	Valid Oracle quoted identifier <sup>1</sup> . If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	tableName or viewName

### See Also:

*Oracle Database SQL Language Reference* for information about valid Oracle quoted identifiers

## 7.3 Key Column Name

The collection metadata component that specifies the name of the column that stores the document key.

Property	Value
Default value	ID
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	keyColumn.name

## 7.4 Key Column Type

The collection metadata component that specifies the SQL data type of the column that stores the document key.

Property	Value
Default value	VARCHAR2
Allowed values	VARCHAR2 NUMBER RAW(16)
JSON collection metadata document path	keyColumn.sqlType

### ▲ Caution:

If client-assigned keys are used and the key column type is `VARCHAR2` then Oracle recommends that the database character set be `AL32UTF8`. This ensures that conversion of the keys to the database character set is lossless.

Otherwise, if client-assigned keys contain characters that are not supported in your database character set then conversion of the key into the database character set during a read or write operation is lossy. This can lead to duplicate-key errors during insert operations. More generally, it can lead to unpredictable results. For example, a read operation could return a value that is associated with a different key from the one you expect.

## 7.5 Key Column Max Length

The collection metadata component that specifies the maximum length of the key column in bytes. This component applies only to keys of type `VARCHAR2`.

Property	Value
Default value	255
Allowed values	At least 32 bytes if key assignment method is <code>UUID</code> or <code>GUID</code> . See <a href="#">Key Column Assignment Method</a> .
JSON collection metadata document path	<code>keyColumn.maxLength</code>

### Related Topics

- [Key Column Type](#)  
The collection metadata component that specifies the SQL data type of the column that stores the document key.

## 7.6 Key Column Assignment Method

The collection metadata component that specifies the method used to assign keys to objects that are inserted into the collection.

Property	Value
Default value	<code>UUID</code>
Allowed values	<code>UUID</code> <code>GUID</code> <code>SEQUENCE</code> <code>CLIENT</code> For descriptions of these methods, see <a href="#">Table 7-1</a> .
JSON collection metadata document path	<code>keyColumn.assignmentMethod</code>

**Table 7-1 Key Assignment Methods**

Method	Description
<code>GUID</code>	Keys are generated in Oracle Database by SQL function <code>SYS_GUID</code> , described in <i>Oracle Database SQL Language Reference</i> .
<code>SEQUENCE</code>	Keys are generated in Oracle Database by a database sequence. If you specify the key assignment method as <code>SEQUENCE</code> then you must also specify the name of that sequence — see <a href="#">Key Column Sequence Name</a> .
<code>CLIENT</code>	Keys are assigned by the client application.
<code>UUID (default)</code>	Keys are generated by SODA, based on the <code>UUID</code> .

## 7.7 Key Column Sequence Name

The collection metadata component that specifies the name of the database sequence that generates keys for documents that are inserted into a collection if the key assignment method is `SEQUENCE`.

If you specify the key assignment method as `SEQUENCE` then you must also specify the name of that sequence. If the specified sequence does not exist then SODA creates it.

Property	Value
Default value	None
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	<code>keyColumn.sequenceName</code>

### Note:

If you drop a collection using SODA, the sequence used for key generation is *not* dropped. This is because it might not have been created using SODA. To drop the sequence, use SQL command `DROP SEQUENCE`, after first dropping the collection.

### Related Topics

- [Key Column Assignment Method](#)  
The collection metadata component that specifies the method used to assign keys to objects that are inserted into the collection.

### See Also:

- *Oracle Database SQL Language Reference* for information about `DROP SEQUENCE`
- *Oracle Database Concepts* for information about database sequences

## 7.8 Content Column Name

The collection metadata component that specifies the name of the column that stores the database content.

Property	Value
Default value	JSON_DOCUMENT
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	<code>contentColumn.name</code>

## 7.9 Content Column Type

The collection metadata component that specifies the SQL data type of the column that stores the document content.

Property	Value
Default value	BLOB
Allowed values	VARCHAR2 BLOB CLOB
JSON collection metadata document path	<code>contentColumn.sqlType</code>

## 7.10 Content Column Max Length

The collection metadata component that specifies the maximum length of the content column in bytes. This component applies only to content of type `VARCHAR2`.

Property	Value
Default value	4000
Allowed values	32767 if extended data types are enabled. Otherwise, 4000 if content column type is <code>VARCHAR2</code> .
JSON collection metadata document path	<code>contentColumn.maxLength</code>

### Related Topics

- [Content Column Type](#)  
The collection metadata component that specifies the SQL data type of the column that stores the document content.

 **See Also:**

*Oracle Database SQL Language Reference* for information about extended data types

## 7.11 Content Column JSON Validation

The collection metadata component that specifies the syntax to which JavaScript Object Notation (JSON) content must conform—strict or lax.

Property	Value
Default value	STANDARD
Allowed values	STANDARD STRICT LAX (default for SQL condition <code>is json</code> )
JSON collection metadata document path	<code>contentColumn.validation</code>

- `STANDARD` validates according to the JSON RFC 4627 standard. (It corresponds to the strict syntax defined for Oracle SQL condition `is json`.)
- `STRICT` is the same as `STANDARD`, except that it also verifies that the document does not contain duplicate JSON field names. (It corresponds to the strict syntax defined for Oracle SQL condition `is json` when the SQL keywords `WITH UNIQUE KEYS` are also used.)
- `LAX` validates more loosely. (It corresponds to the lax syntax defined for Oracle SQL condition `is json`.) Some of the relaxations that `LAX` allows include the following:
  - It does not require JSON field names to be enclosed in double quotation marks (").
  - It allows uppercase, lowercase, and mixed case versions of `true`, `false`, and `null`.
  - Numerals can be represented in additional ways.

 **See Also:**

- *Oracle Database JSON Developer's Guide* for information about strict and lax JSON syntax
- The `application/json` Media Type for JavaScript Object Notation (JSON) for the JSON RFC 4627 standard

## 7.12 Content Column SecureFiles LOB Compression

The collection metadata component that specifies the SecureFiles LOB compression setting.

Property	Value
Default value	NONE
Allowed values	NONE HIGH MEDIUM LOW
JSON collection metadata document path	<code>contentColumn.compress</code>

 **See Also:**

*Oracle Database SecureFiles and Large Objects Developer's Guide* for information about SecureFiles LOB storage

## 7.13 Content Column SecureFiles LOB Cache

The collection metadata component that specifies the SecureFiles LOB cache setting.

Property	Value
Default value	TRUE
Allowed values	TRUE FALSE
JSON collection metadata document path	<code>contentColumn.cache</code>

 **See Also:**

*Oracle Database SecureFiles and Large Objects Developer's Guide* for information about SecureFiles LOB storage

## 7.14 Content Column SecureFiles LOB Encryption

The collection metadata component that specifies the SecureFiles LOB encryption setting.

Before you create a collection that uses SecureFiles LOB encryption you must set up an encryption wallet.



Property	Value
Default value	NONE
Allowed values	NONE 3DES168 AES128 AES192 AES256
JSON collection metadata document path	contentColumn.encrypt

#### See Also:

- *Oracle Database SecureFiles and Large Objects Developer's Guide* for information about SecureFiles LOB storage
- *Oracle Database SQL Language Reference* for information about how to set up an encryption wallet using the `SET ENCRYPTION WALLET` clause of the `ALTER SYSTEM` statement

## 7.15 Version Column Name

The collection metadata component that specifies the name of the column that stores the document version.

Property	Value
Default value	VERSION
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	versionColumn.name

## 7.16 Version Column Generation Method

The collection metadata component that specifies the method used to compute version values for objects when they are inserted into a collection or replaced.

Property	Value
Default value	SHA256

Property	Value
Allowed values	UUID
	TIMESTAMP
	MD5
	SHA256
	SEQUENTIAL
	NONE
JSON collection metadata document path	<code>versionColumn.method</code>

[Table 7-2](#) describes the version generation methods.

**Table 7-2 Version Generation Methods**

Method	Description
UUID	Ignoring object content, SODA generates a universally unique identifier (UUID) when the document is inserted and for every replace operation. Efficient, but the version changes even if the original and replacement documents have identical content. Version column type value is <code>VARCHAR2(255)</code> .
TIMESTAMP	Ignoring object content, SODA generates a value from the time stamp and converts it to <code>LONG</code> . This method might require a round trip to the database instance to get the time stamp. As with <code>UUID</code> , the version changes even if the original and replacement documents have identical content. Version column type value is <code>NUMBER</code> .
MD5	SODA uses the MD5 algorithm to compute a hash value of the document content. This method is less efficient than <code>UUID</code> , but the version changes only if the document content changes. Version column type value is <code>VARCHAR2(255)</code> .
SHA256 (default)	SODA uses the SHA256 algorithm to compute a hash value of the document content. This method is less efficient than <code>UUID</code> , but the version changes only if the document content changes. Version column type value is <code>VARCHAR2(255)</code> .
SEQUENTIAL	Ignoring object content, SODA assigns version 1 when the object is inserted and increments the version value every time the object is replaced. Version values are easily understood by human users, but the version changes even if the original and replacement documents have identical content. Version column type value is <code>NUMBER</code> .
NONE	If the version column is present, <code>NONE</code> means that the version is generated outside SODA (for example, by a database trigger).

## 7.17 Last-Modified Time Stamp Column Name

The collection metadata component that specifies the name of the column that stores the last-modified time stamp of the document.

Property	Value
Default value	LAST_MODIFIED
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	lastModifiedColumn.name

## 7.18 Last-Modified Column Index Name

The collection metadata component that specifies the name of the index on the last-modified column.

The value of this component is the name of a nonunique index on the last-modified time-stamp column. The index is created if a name is specified. This index can improve the performance of read and write operations that are driven by last-modified time stamps.

Only SODA for REST provides such an operation (operation `GET` collection with time-stamp parameters `since` and `until`). Other implementations do not use this component, since they do not provide any read or write operations that are driven by last-modified time stamps. Even for SODA for REST, it is typically better not to set this component if you are sure that your application does not use any read or write operations that are driven by time stamps, because creating and maintaining an index carries a cost.

Property	Value
Default value	None
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	lastModifiedColumn.index



### See Also:

*Oracle REST Data Services SODA for REST Developer's Guide*

## 7.19 Creation Time Stamp Column Name

The collection metadata component that specifies the name of the column that stores the creation time stamp of the document. This time stamp is generated during the `insert`, `insertAndGet`, `save`, or `saveAndGet` operation.

Property	Value
Default value	CREATED_ON
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters, SODA replaces them with underscore characters (_).
JSON collection metadata document path	creationTimeColumn.name

## 7.20 Media Type Column Name

The collection metadata component that specifies the name of the column that stores the media type of the document. A media type column is needed if the collection is to be heterogeneous, that is, it can store documents other than JavaScript Object Notation (JSON).

 **Note:**

You cannot use query-by-example (QBE) with a heterogeneous collection. An error is raised if you try to do so.

Property	Value
Default value	None
Allowed values	Valid Oracle quoted identifier <sup>1</sup> (as defined in <i>Oracle Database SQL Language Reference</i> ). If this value contains double quotation marks (") or control characters then SODA replaces them with underscore characters (_).
JSON collection metadata document path	mediaTypeColumn.name

## 7.21 Read Only

The collection metadata component that specifies whether the collection is read-only.

Property	Value
Default value	FALSE
Allowed values	TRUE FALSE

<b>Property</b>	<b>Value</b>
JSON collection metadata document path	readOnly

# 8

## SODA Guidelines and Restrictions

General guidelines and restrictions that apply across SODA implementations are presented.

- [SODA Guidelines](#)  
Guidelines that apply across SODA implementations are described.
- [SODA Restrictions \(Reference\)](#)  
Restrictions that apply across SODA implementations are described.

### 8.1 SODA Guidelines

Guidelines that apply across SODA implementations are described.

- *AL32UTF8 database character set* — Oracle recommends<sup>1</sup> that you use AL32UTF8 (Unicode) for your database character set. Otherwise:
  - Data can be altered by SODA when documents are written to a collection, because of lossy conversion to the database character set. (This affects only collections stored as `VARCHAR2` and `CLOB` data; collections stored as `BLOB` data do not depend on the database character set.
  - Query-by-example (QBE) can return unpredictable results.
- *Re-creating a collection*<sup>2</sup> — Do *not* drop a collection and then re-create it with *different metadata* if there is any application running that uses the collection in any way. Shut down any such applications before re-creating the collection, so that all live SODA objects are released.

There is no problem just dropping a collection. Any read or write operation on a dropped collection raises an error. And there is no problem dropping a collection and then re-creating it with the same metadata. But if you re-create a collection with different metadata, and if there are any live applications using SODA objects, then there is a risk that a stale collection is accessed, and *no error is raised* in this case.

#### Note:

In SODA implementations that allow collection metadata caching, such as SODA for Java, this risk is increased if such caching is enabled. In that case, a cache can return an entry for a stale collection object even if the collection has been dropped.

<sup>1</sup> SODA for C *requires* that you use AL32UTF8 as the database character set.

<sup>2</sup> Day-to-day use of a typical application that makes use of SODA does not require that you drop and re-create collections. But if you need to do that for any reason then this guideline applies.

 **See Also:**

- [Key Column Type](#) for information about the importance of using AL32UTF8 with client-assigned document keys
- *Oracle Database SODA for Java Developer's Guide* for information about collection metadata caching

## 8.2 SODA Restrictions (Reference)

Restrictions that apply across SODA implementations are described.

- *Document size:*
  - For SODA for REST and SODA for Java the limit is approximately 2 gigabytes.
  - For SODA for PL/SQL the size is limited by the maximum possible LOB size.

 **See Also:**

*Oracle Database SQL Language Reference* for information about the maximum size for BLOB and CLOB

 **Note:**

You must ensure that you have sufficient RAM to support your workload.

- *JSON document content:* In SODA, JSON content must conform to RFC 4627. In particular, JSON content must be either an object or an array; it cannot be a scalar value. For example, according to RFC 4627, the string value "hello" is not, by itself, valid JSON content. In addition, SODA JSON content can be UTF-8 or UTF-16 (big endian (BE) or little endian (LE)). Although RFC 4627 also allows UTF-32 (BE and LE) encodings, SODA does not support them. Some implementations may support additional, non-Unicode, encodings.

# Index

## Symbols

---

, character (comma), path syntax, [4-1](#)  
. character (period), path syntax, [4-1](#)  
[ and ] characters (brackets), path syntax, [4-1](#)  
\* character (asterisk), path syntax, [4-1](#)  
` character (backquote), path syntax, [4-1](#)  
\$ character (dollar sign)  
    escaping in QBE path, [4-1](#)  
    in operator names, [5-1](#)  
\$, prefix for QBE operator names, [2-1](#)

\$or operator, [5-21](#)  
    overview, [2-9](#)  
\$orderby operator, [5-2](#)  
    overview, [2-12](#)  
\$query operator, [5-2](#)  
\$regex operator, [5-9](#)  
\$size operator, [5-14](#)  
\$startsWith operator, [5-9](#)  
\$string operator, [5-14](#)  
\$timestamp operator, [5-14](#)  
\$type operator, [5-14](#)  
\$upper operator, [5-14](#)  
\$within operator, [5-27](#)

## A

---

array index (position), [4-1](#)  
array step (QBE path), definition, [4-1](#)  
asterisk character, path syntax, [4-1](#)

## B

---

B-tree index  
    details, [6-1](#)  
    overview, [3-1](#)  
backquote character, path syntax, [4-1](#)  
bracket characters, path syntax, [4-1](#)

## C

---

collection, [1-5](#)  
    heterogeneous, [2-1](#)  
        definition, [1-5](#)  
        media type column name, [7-13](#)  
collection configuration, [7-1](#)  
collection metadata  
    components of, [7-1](#)  
    content column JSON validation, [7-8](#)  
    content column max length, [7-7](#)  
    content column name, [7-7](#)  
    content column SecureFiles LOB cache, [7-9](#)  
    content column SecureFiles LOB  
        compression, [7-9](#)



collection metadata (*continued*)

- content column SecureFiles LOB encryption, [7-9](#)
- content column type, [7-7](#)
- creation time stamp column name, [7-13](#)
- default and custom, [1-1](#)
- key column assignment method, [7-5](#)
- key column max length, [7-5](#)
- key column name, [7-4](#)
- key column sequence name, [7-6](#)
- key column type, [7-4](#)
- last-modified column index name, [7-12](#)
- last-modified time stamp column name, [7-11](#)
- media type column name, [7-13](#)
- read only, [7-13](#)
- schema, [7-3](#)
- table or view, [7-3](#)
- version column name, [7-10](#)
- version generation method, [7-10](#)

collection table name, [1-9](#)

comma character, path syntax, [4-1](#)

comparison clause

- definition, [5-9](#)

comparison operator

- definition, [5-9](#)

comparison QBE operators

- overview, [2-5](#)

components, document, [1-1](#)

composite filter specification, [5-2](#)

condition

- definition, [5-6](#)

condition-operator clause

- definition, [5-8](#)

contains clause

- definition, [5-25](#)

content column JSON validation collection

- metadata component, [7-8](#)

content column max length collection metadata

- component, [7-7](#)

content column name collection metadata

- component, [7-7](#)

content column SecureFiles LOB cache

- collection metadata component, [7-9](#)

content column SecureFiles LOB compression

- collection metadata component, [7-9](#)

content column SecureFiles LOB encryption

- collection metadata component, [7-9](#)

content column type collection metadata

- component, [7-7](#)

creation time stamp column name collection

- metadata component, [7-13](#)

CRUD operations, [1-1](#)

---

## D

data guide

- details, [6-1](#)
- overview, [3-1](#)

database, SODA, [1-1](#)

date and time formats, ISO 8601, [5-20](#)

document, [1-3](#)

document collection, [1-5](#)

document components, [1-1](#)

document key, [1-1](#)

- matching in QBE, [5-24](#)

document metadata, [1-1](#)

dollar sign, for QBE operator, [2-1](#)

dollar-sign character

- escaping in QBE path, [4-1](#)
- in operator names, [5-1](#)

---

## E

empty filter condition ({}), [5-6](#)

empty query, [5-1](#)

equality, scalar, [5-7](#)

---

## F

field step (QBE path), definition, [4-1](#)

field-condition clause

- definition, [5-8](#)

filter

- definition, [5-1](#)

filter condition

- definition, [5-6](#)

filter specification, [1-1](#), [2-1](#)

- definition, [5-1](#)
- details, [5-1](#)

full-text index,

- details, [6-1](#)
- overview, [3-1](#)

---

## G

guidelines, [8-1](#)

---

## H

heterogeneous collection, [2-1](#)

- definition, [1-5](#)
- media type column name, [7-13](#)

---

## I

ID clause, [5-24](#)

implicit \$and operator, [5-22](#)

index (position), array, [4-1](#)  
 index specification  
   details, [6-1](#)  
 index specifications  
   overview, [3-1](#)  
 ISO 8601 date and time formats, [5-20](#)  
 item-method clause  
   definition, [5-14](#)  
 item-method equality clause  
   definition, [5-14](#)  
 item-method modifier clause  
   definition, [5-14](#)  
 item-method QBE operators, [5-14](#)  
   \$abs, [5-14](#)  
   \$boolean, [5-14](#)  
   \$ceiling, [5-14](#)  
   \$date, [5-14](#)  
   \$double, [5-14](#)  
   \$floor, [5-14](#)  
   \$length, [5-14](#)  
   \$lower, [5-14](#)  
   \$number, [5-14](#)  
   \$size, [5-14](#)  
   \$string, [5-14](#)  
   \$timestamp, [5-14](#)  
   \$type, [5-14](#)  
   \$upper, [5-14](#)  
   overview, [2-7](#)

## K

---

key column assignment method collection  
   metadata component, [7-5](#)  
 key column max length collection metadata  
   component, [7-5](#)  
 key column name collection metadata  
   component, [7-4](#)  
 key column sequence name collection metadata  
   component, [7-6](#)  
 key column type collection metadata component,  
   [7-4](#)  
 key, document, [1-1](#)  
   matching in QBE, [5-24](#)

## L

---

last-modified column index name collection  
   metadata component, [7-12](#)  
 last-modified time stamp column name collection  
   metadata component, [7-11](#)  
 lax field, spatial index specification  
   details, [6-1](#)  
   overview, [3-1](#)  
 limitations, [8-2](#)

logical combining clause  
   definition, [5-21](#)  
 logical combining operator  
   definition, [5-21](#)  
 logical combining operators  
   overview, [2-9](#)

## M

---

media type column name collection metadata  
   component, [7-13](#)  
 metadata, collection and document, [1-1](#)  
 modifiers  
   See item-method QBE operators

## N

---

nested conditions, [2-11](#)  
 nested-condition clause, [5-23](#)  
 not clause  
   definition, [5-13](#)

## O

---

omitting \$and operator, [5-22](#)  
 omitting \$eq operator, [5-9](#)  
 operand, for QBE operator  
   definition, [5-1](#)  
 operand, QBE, [2-1](#), [5-1](#)  
 operator  
   \$abs, [5-14](#)  
   \$all, [5-9](#)  
   \$and, [5-21](#)  
     omitting, [2-9](#)  
     overview, [2-9](#)  
   \$between, [5-9](#)  
   \$boolean, [5-14](#)  
   \$ceiling, [5-14](#)  
   \$contains, [5-25](#)  
   \$date, [5-14](#)  
   \$double, [5-14](#)  
   \$eq, [5-9](#)  
     omitting, [5-9](#)  
   \$exists, [5-9](#)  
   \$floor, [5-14](#)  
   \$gt, [5-9](#)  
   \$gte, [5-9](#)  
   \$id, [5-24](#)  
     overview, [2-12](#)  
   \$in, [5-9](#)  
   \$intersects, [5-27](#)  
   \$length, [5-14](#)  
   \$lower, [5-14](#)  
   \$lt, [5-9](#)  
   \$lte, [5-9](#)

operator (*continued*)

- \$ne, [5-9](#)
- \$near, [5-27](#)
- \$nin, [5-9](#)
- \$nor, [5-21](#)
- overview, [2-9](#)
- \$not, [5-13](#)
- overview, [2-7](#)
- \$number, [5-14](#)
- \$or, [5-21](#)
- overview, [2-9](#)
- \$orderby, [5-2](#)
- overview, [2-12](#)
- \$query, [5-2](#)
- \$regex, [5-9](#)
- \$size, [5-14](#)
- \$startsWith, [5-9](#)
- \$string, [5-14](#)
- \$timestamp, [5-14](#)
- \$type, [5-14](#)
- \$upper, [5-14](#)
- \$within, [5-27](#)

operator, QBE, [2-1](#), [5-1](#)

orderby clause, [5-3](#)

ordinary characters, definition, [4-1](#)

## P

---

path, QBE, [2-4](#), [4-1](#)

period character, path syntax, [4-1](#)

## Q

---

### QBE

- definition, [5-1](#)
- operand, [2-1](#), [5-1](#)
- operator, [2-1](#), [5-1](#)

QBE (query by example), [1-1](#)

QBE (query-by-example), [2-1](#)

### QBE operators

- \$all, [5-9](#)
- \$and, [5-21](#)
- \$between, [5-9](#)
- \$eq, [5-9](#)
- \$exists, [5-9](#)
- \$gt, [5-9](#)
- \$gte, [5-9](#)
- \$id, [5-24](#)
- overview, [2-12](#)
- \$in, [5-9](#)
- \$intersects, [5-27](#)
- \$lax
  - for \$orderby, [5-3](#)
  - for QBE spatial clause, [5-27](#)
- \$lt, [5-9](#)

### QBE operators (*continued*)

- \$lte, [5-9](#)
- \$ne, [5-9](#)
- \$near, [5-27](#)
- \$nin, [5-9](#)
- \$nor, [5-21](#)
- \$not, [5-13](#)
- overview, [2-7](#)
- \$or, [5-21](#)
- \$orderby, [5-2](#), [5-3](#)
- overview, [2-12](#)
- \$query, [5-2](#)
- \$regex, [5-9](#)
- \$scalarRequired
  - for \$orderby, [5-3](#)
  - for QBE spatial clause, [5-27](#)
- \$startsWith, [5-9](#)
- \$within, [5-27](#)
- comparison
  - overview, [2-5](#)
- item-method, [5-14](#)
- overview, [2-7](#)
- spatial
  - overview, [2-14](#)

QBE path, [2-4](#), [4-1](#)

query by example (QBE), [1-1](#)

query-by-example, [2-1](#)

query-by-example (QBE)

definition, [5-1](#)

## R

---

read only collection metadata component, [7-13](#)

restrictions, [8-2](#)

## S

---

sample JSON documents used in examples, [2-3](#)

scalar-equality clause

definition, [5-7](#)

scalarRequired field, index specification

details, [6-1](#)

scalarRequired field, index specifications

overview, [3-1](#)

schema collection metadata component, [7-3](#)

scoping fields to a parent field in QBE, [5-23](#)

search index

details, [6-1](#)

overview, [3-1](#)

SODA database, [1-1](#)

SODA guidelines, [8-1](#)

SODA implementations, [1-1](#)

SODA limitations, [8-2](#)

SODA operator

definition, [5-1](#)

- SODA restrictions, [8-2](#)
- sorting JSON data returned by a QBE, [5-3](#)
- spatial clause
  - definition, [5-27](#)
- spatial index
  - details, [6-1](#)
  - overview, [3-1](#)
- spatial operator
  - \$intersects, [5-27](#)
  - \$near, [5-27](#)
  - \$within, [5-27](#)
- spatial QBE operators
  - overview, [2-14](#)
- special-criterion clause, [5-24](#)
- specification
  - filter
    - details, [5-1](#)
  - index
    - details, [6-1](#)
- specifications
  - index
    - overview, [3-1](#)

- specifications (*continued*)
  - index (*continued*)
- SQL/JSON operators, [1-1](#)
- square bracket characters, path syntax, [4-1](#)
- syntactic characters, definition, [4-1](#)
- syntax, QBE path, [4-1](#)

## T

---

- table name, collection, [1-9](#)
- table or view collection metadata component, [7-3](#)
- time and date formats, ISO 8601, [5-20](#)

## V

---

- version column name collection metadata component, [7-10](#)
- version generation method collection metadata component, [7-10](#)

## W

---

- wildcard character, path syntax, [4-1](#)