
**Information technology — Concepts
and usage of metadata —**

**Part 21:
11179-3 Data model in SQL**

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see <https://patents.iec.ch>).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 32, *Data management and interchange*.

A list of all parts in the ISO/IEC 19583 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

ISO/IEC 11179-3^[1] provides a specification for a registry in which information about metadata can be recorded and maintained.

The metamodel to instantiate such a registry is expressed in text as a conceptual model. This conceptual model is illustrated with a series of diagrams which use the class diagram notation from the Unified Modeling Language (UML)^{[2][3]}.

Instantiators and users of the registries described in ISO/IEC 11179-3 require further guidance to turn the conceptual models into concrete instantiations. This document provides a possible instantiation of the registry metamodel specified in ISO/IEC 11179-3 using the SQL database language as specified in ISO/IEC 9075^[4].

This specimen instantiation is provided to increase the understanding of ISO/IEC 11179-3 and, hence, to promote its adoption.

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Information technology — Concepts and usage of metadata —

Part 21: 11179-3 Data model in SQL

1 Scope

This document provides a possible instantiation of the registry metamodel specified in ISO/IEC 11179-3 using the SQL database language as specified in ISO/IEC 9075-2.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Overview of the relationship between UML Class Diagrams and SQL

The Unified Modeling Language (UML) provides a family of graphical notations that can be used in the analysis and design of software systems. The UML is under the control of the Object Management Group (OMG) and, as such, it is (a) a relatively 'open' standard, and (b) firmly rooted in the object-oriented paradigm for software engineering. The UML is now at Version 2 and is the subject of two international standards: ISO/IEC 19505-1 and ISO/IEC 19505-2.

Within the UML, the Class Diagram notation is used to represent information (and, hence, data) requirements for a particular 'universe of discourse', a business area or the scope of a proposed information system.

A UML Object is often defined as a:

construct within a system for which a set of attributes and operations can be specified.

Whilst this is a reasonable definition within the context of object-oriented system development, a more appropriate definition of an Object for the purposes of this document is a:

representation of something of interest within the universe of discourse about which information needs to be recorded.

An Object Class in both contexts can then defined as a:

definition of a set of Objects that share the same attributes, associations, and operations.

The Database Language SQL is a, largely, declarative language used to manage structured data held in a database under the control of a Relational Database Management System (RDBMS). As such, it

was originally based on Edgar F. Codd's relational model of data published in 1970^[5], but its scope has grown over the years. SQL is the subject of the multi-part set of International Standards, ISO/IEC 9075 series. Most commercial SQL products, however, deviate from the standards to some extent, some more than others.

5 Generating the SQL for the metamodel

5.1 Overview

The UML (and the Class Diagrams, in particular) and the SQL database language exist in two separate programming paradigms and there is, therefore, no direct translation from one (the UML) to the other (SQL). There are, however, approaches that can be taken to achieve a translation. This document uses one of those approaches to generate a set of SQL statements to instantiate the metadata registry metamodel, where the SQL statements enable easy reference back to the original UML Class Diagram and text of the metamodel. This is achieved by using names for the SQL objects that reflect the names of the UML artefacts and, also, by embedding comments referencing the metamodel within the SQL statements.

5.2 General principles for the translation of a UML Class diagram into SQL statements

It is good practice to distinguish between SQL keywords and the names given to the SQL objects. One convention is to use UPPER CASE for the keywords and lower_case (using snake case) for the object names.

Each UML class is represented by an SQL table. To make correlation to the model easier, the name of a table that represents a class is the same as that of the class.

Each composite datatype is also represented by an SQL table. To make correlation to the model easier, the name of the table is the same as that of the datatype.

Each single-valued attribute of a class or a composite datatype is represented by a column in the appropriate table. The name of this column is the same as that of the attribute in the class or datatype. The datatype of an attribute column is intuitively selected to be similar to that of the datatype of the attribute.

If the datatype of an attribute of a class is another class or a composite datatype, the column that represents that attribute is additionally declared as a foreign key column referencing the relevant table that represents the class or composite datatype.

Where an attribute is multivalued (that is, it has a multiplicity of [0..*] or [1..*] in the UML diagram) there are two possible instantiations available. These are:

- a) Use one of the collection types, MULTISET or ARRAY, available in SQL.
- b) Create a new table, a characteristic table, to hold the multiple values, with each row in the table having a foreign key referencing the kernel (prime) table and one of the values.

In object-orientation, and, hence, UML, there is no equivalent of the SQL primary key, so each table that represents a class or a composite datatype has an additional column that is used as a surrogate identifier. This column then becomes the primary key for the table.

UNIQUE or CHECK constraints may be added to a table where required. The latter are used, for example, to control the valid values for a column or to control which columns should, or should not, take values in different circumstances.

Specialization hierarchies (superclasses and their subclasses) can be instantiated in one of two ways using SQL structures.

- 1) It is possible to integrate all the classes (the superclass and its subclasses) into one table, named after the superclass, which includes a column for each attribute of the superclass, with those

columns representing mandatory attributes being declared NOT NULL, and columns for each of the attributes of the subclasses. None of these subclass columns are declared as NOT NULL, irrespective of whether they are mandatory or optional within their subclass. An additional column, often called a discriminator column, with possible values representing each of the subclasses and a CHECK constraint are provided to manage which columns are populated for each subclass. Where a subclass is related to another class via a one-to-many association, such that there is a foreign key in the table representing the other class, a cross-table constraint is needed to ensure that a row in the other table will only exist if the value of the discriminator column represents the relevant subclass in the inheritance relationship.

- 2) Another possibility is the creation of a separate table for the superclass and the creation of additional tables for each of the subclasses. When the hierarchy is complete, disjoint and static (the normal situation in most models), a fully mandatory 'one-to-one' relationship is provided between the table representing the superclass and each table representing the subclasses. To achieve this, the primary key of each subclass table is also declared as a foreign key referencing the superclass table. Cross-table constraints are needed to ensure that for each row in the superclass table there is a corresponding row in one of the subclass tables, and that there is no duplication of primary key values across the tables representing the subclasses.

There are a number of different approaches that can be used when translating UML Class Diagram associations into SQL. Since each association in the metadata registry metamodel is named, the approach used in this document is to create a table for each association, with the table named with the name of the association.

Some many-to-many associations are annotated with association classes. These association classes also become tables.

5.3 Specific approaches taken for the translation of the metadata registry metamodel

5.3.1 Overview

The following subclauses provide specific detail about the translation of the metamodel artefacts, where the information in [5.2](#) is either not applicable or insufficient.

5.3.2 Obligations

In the metamodel the obligation applicable to each attribute or association are described as one of "Mandatory", "Conditional" or "Optional", with these obligations being enforced if, and only if, the Registration Status of the associated metadata item is Recorded or higher, that is, if the Registration Status of the associated item is one of "Recorded", "Qualified", "Standard" or "Preferred Standard". The obligations are not enforced if the Registration Status of the associated item is one of "Candidate", "Incomplete", "Retired" and "Superseded".

Any registry instantiation has to be able to register items with a lower Registration Status than "Recorded", and the obligations cannot, therefore, be simply enforced.

The example SQL instantiation allows the attributes and associations to be optional so that items with a Registration Status lower than "Recorded" can be accommodated. The obligations applicable to items with a Registration Status of "Recorded" or higher will, therefore, need to be enforced in the registry application as opposed to the register (the database) itself.

5.3.3 Translation of datatypes

The datatypes used in the metamodel can be considered to be 'primitive' or more complex.

The primitive datatypes are translated as described in [Table 1](#).

Table 1 — Translation of the primitive datatypes

Metadata registry metamodel datatype	Examples or Comment	SQL Datatype
Boolean		This simply translates as a column of type BOOLEAN
Date		This simply translates as a column of type DATE
Datetime		This simply translates as a column of type TIMESTAMP
Integer		This simply translates as a column of type INTEGER
Notation	XCL Common Logic, OWL-DL XML	This translates as a column of type CHARACTER VARYING (2500)
Sign	This could be a bit string, but, at a minimum, String must be supported.	This translates as a column of type CHARACTER VARYING (2500). If the SQL implementation supports the BINARY LARGE OBJECT type, this could be used instead.
String		This translates as a column of type CHARACTER VARYING (255)
Text		This translates as a column of type CHARACTER VARYING (2500). If the SQL implementation supports the CHARACTER LARGE OBJECT type, this could be used instead.

The more complex datatypes are translated as described in [Table 2](#).

Table 2 — Translation of the more complex datatypes

Metadata registry metamodel datatype	Examples or Comment	SQL Datatype
Natural_Range	0, 1, 2, 1..2, 2..8, 0..*, 3..*	This is instantiated with three columns, one INTEGER column for the lower bound, one INTEGER column for the fixed upper bound, and a CHARACTER column, defaulting to 'many', for the many upper bound. The columns are then managed with a CHECK constraint.
Value	This represents a value of any of the types listed above	This is instantiated using many different columns, one, or more, for each of the datatypes listed and then a CHECK constraint implemented to ensure that only one datatype is represented.
Phone_Number		A table is created (named cdt_phone_number) with columns as specified in ISO/IEC 19773[6]; the table has a surrogate primary key of datatype INTEGER. Tables representing classes that have attributes specified with this datatype have foreign keys that reference cdt_phone_number.
Postal_Address		A table is created (named cdt_postal_address) with columns as specified in ISO/IEC 19773[6]; the table has a surrogate primary key of datatype INTEGER. Tables representing classes that have attributes specified with this datatype have foreign keys that reference cdt_postal_address.

5.3.4 Translation of the basic classes

Each basic class in the metamodel is represented by a table, with the name prefixed by cls_. Each table representing a basic class has a surrogate primary key of type INTEGER.

5.3.5 Translation of the <<type>> stereotypes

Some classes in the metamodel are used as stereotypes marked <<type>>, enabling other classes to be 'typed'; that is, to be identified, designated or classified. These classes are instantiated as tables with the names prefixed by typ_. Each of these tables representing a superclass in a specialization hierarchy has

a surrogate primary key of type INTEGER. Those tables that are then subclasses inherit the surrogate primary key of the superclass, with that same primary key also being declared as a foreign key.

Those classes that can be 'typed' are then subject to a set of ALTER TABLE statements to add columns and foreign keys to reference the tables representing the <<type>> classes.

5.3.6 Translation of the remaining classes

Each of the remaining classes in the metamodel is represented by a table, with the name prefixed by cls_. Each table representing a class has a surrogate primary key of type INTEGER.

5.3.7 Translation of specialization hierarchies

Each superclass and its subclasses are represented by separate tables. Those tables that represent subclasses inherit the surrogate primary key of the superclass, either as the primary key or as an additional column, with that inherited primary key also being declared as a foreign key. This is normally achieved by ALTER TABLE statements after the creation of the table.

5.3.8 Translation of the association classes

Each association class in the metamodel is represented by a table, with the name prefixed by asscls_. Each table representing an association class has a surrogate primary key of type INTEGER, a column, or columns representing the attributes of the association class, and two additional columns: one each for the roles of the association class, both of which have datatype INTEGER and are specified as foreign keys referencing the tables representing the relevant classes.

5.3.9 Translation of the attributes of the classes

Where the metamodel datatype of the attribute is listed in the first column of [Table 1](#), the attribute is translated as a single column of the relevant table representing the parent class, with a datatype as specified in the third column of [Table 1](#).

Where the metamodel datatype of the attribute is listed in the first column of [Table 2](#), the attribute is instantiated as specified in the third column of [Table 2](#).

Where the attribute is a multivalued attribute, there are three options available:

- Where the metamodel datatype is specified in [Table 1](#) and the values are unordered, a separate characteristic table, prefixed mva_, is created with a column for the multivalued attribute specified with the SQL datatype identified in [Table 1](#). The second column in this table is a foreign key column referencing the table representing the class that specifies the attribute. Both columns are declared as the primary key. If the SQL implementation supports the MULTiset collection type, this can be used instead of creating the characteristic table.
- Where the datatype is specified in [Table 1](#) and the values are specified as being ordered, or it makes sense to order them, a separate characteristic table, prefixed mva_, is created with a column for the multivalued attribute specified with the SQL datatype identified in [Table 1](#). The second column in this table is a column of datatype INTEGER named 'priority' to indicate the order of the value. The third column in this table is a foreign key column referencing the table representing the class that specifies the attribute. All three columns are declared as the primary key. If the SQL implementation supports the ARRAY collection type, this could be used instead of creating the characteristic table.
- Where the datatype is specified in [Table 2](#), a separate characteristic table, prefixed mva_, is created with a column for the multivalued attribute specified with the datatype INTEGER and as a foreign key referencing the table representing the complex datatype. The second column in this table is a foreign key column referencing the table representing the class that specifies the attribute. Both columns are declared as the primary key.

Where the datatype of the attribute is specified as another class specified in the metamodel, the attribute is instantiated as a column specified with the datatype INTEGER and as a foreign key referencing the table representing the class that is specified as the datatype in the metamodel. Where feasible, this column is included in the CREATE TABLE statement. If this is not feasible, later ALTER TABLE statements are used to add the column and the foreign key.

5.3.10 Translation of the associations

Each association in the metamodel is represented by a table, with the name prefixed by ass_. Each table representing an association has two columns: one each for the roles of the association, both of which have datatype INTEGER and are specified as foreign keys referencing the tables representing the relevant classes.

Each association is one of three basic types, as follows:

- A one-to-many association: In this case, the column referencing the class at the many end is specified as the primary key of the table.
- A many-to-many association: In this case, both columns are declared as the primary key of the table.
- A one-to-one association: In this case, both columns are declared as the primary key of the table, as for the many-to-many association, but, in addition, each column is declared with a UNIQUE constraint to enforce the one-to-oneness.

5.3.11 Cross-table constraints

Because obligations specified in the metamodel are only applicable if, and only if, the Registration Status of the associated metadata item is Recorded or higher, very few of the constraints needed to enforce the obligations are included in the example SQL.

The only cross-table constraints included are those to ensure that, where appropriate, subclasses are disjoint. This is done by checking that there are no duplicate values for the primary keys across all of the subclasses in the hierarchy. There are only two disjoint hierarchies in the metamodel: the hierarchy with Registered_Item as the superclass and the hierarchy with Concept as the superclass.

To check for 'disjointness', it is necessary to ensure that, for each of the subclasses, no other subclasses within the hierarchy has a primary key value the same as a primary key value for the subclass being checked.

In the example SQL this is achieved by creating a trigger for each subclass. If the SQL implementation supports ASSERTIONS, they can be used instead.

6 Example SQL for instantiation of the metamodel

The complete set of SQL statements needed to provide this example SQL instantiation is at [Annex A](#).

The statements are provided in the following order:

- a) CREATE TABLE statements to create the tables to represent the two complex datatypes, the Phone_Number class and the Postal_Address class.
- b) CREATE TABLE statements to create the tables to represent the basic classes, with additional characteristic tables to represent multi-valued attributes where needed.
- c) CREATE TABLE statements to create the tables to represent the <<type>> classes. These tables are created in an order that allows for the instantiation of specialization of the Identified_Item class.
- d) CREATE TABLE statements to create the tables to represent the remaining classes. These tables are created in alphabetical order.

- e) CREATE TABLE statements to create the tables to represent the association classes. These tables are also created in alphabetical order. Additional characteristic tables are created to represent multi-valued attributes where needed
- f) ALTER TABLE statements to add columns and foreign keys as necessary to the already created tables to add the attributes that were omitted when the tables were created because the datatype of the attribute is another class.
- g) ALTER TABLE statements to add columns and foreign keys as necessary to the already created tables to instantiate subclassing where appropriate.
- h) ALTER TABLE statements to add columns and foreign keys to the already created tables for those classes in the metamodel that can be 'typed' so that they can be identified, designated or classified.
- i) CREATE TABLE statements to create the tables to represent the metamodel associations.
- j) CREATE TRIGGER statements to create the triggers to ensure 'disjointness' within specialization hierarchies.

This set of SQL statements does not provide the most optimal instantiation of a database for a metadata registry, but it does provide an instantiation that can easily be traced back to the metamodel.

Annex A (informative)

Example SQL to instantiate the ISO/IEC 11179-3 metamodel

```

/* ----- */
/* example ISO/IEC 9075 SQL statements to instantiate the */
/* ISO/IEC 11179-3:2013 metamodel as an SQL database */
/* ----- */

/* ----- */
/* create tables for 11179-3 complex datatypes */
/* ----- */

CREATE TABLE cdt_phone_number
(
  /* surrogate primary key */
  phone_number_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  international_numbering_plan_prefix CHARACTER VARYING(255) ,
  country_code             CHARACTER VARYING(255) ,
  city_code                CHARACTER VARYING(255) ,
  local_number             CHARACTER VARYING(255) NOT NULL ,
  extension                CHARACTER VARYING(255)
);

CREATE TABLE cdt_postal_address
(
  /* surrogate primary key */
  postal_address_id        INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  sub_building_name        CHARACTER VARYING(255) ,
  building_name            CHARACTER VARYING(255) ,
  throughfare              CHARACTER VARYING(255) ,
  dependent_locality       CHARACTER VARYING(255) ,
  post_town                CHARACTER VARYING(255) ,
  region                   CHARACTER VARYING(255) ,
  postcode                 CHARACTER VARYING(255) ,
  country                  CHARACTER VARYING(255)
);

/* ----- */
/* create tables for 11179-3 basic classes */
/* ----- */

CREATE TABLE cls_organization
(
  /* surrogate primary key */
  organization_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  mail_address             INTEGER          REFERENCES cdt_postal_address (postal_address_id) ,
  uri                     CHARACTER VARYING(250)
  /* the multi-valued attributes name, email_address and phone_number are */
  /* instantiated as the characteristic tables mva_organization_names, */
  /* mva_organization_email_addresses and mva_organization_phone_numbers */
);

```

```

CREATE TABLE mva_organization_names
(
    /* column to represent multi-valued attribute */
    name CHARACTER VARYING(2500) ,
    /* identification of the organization this name belongs to */
    owning_organization_id INTEGER
    REFERENCES cls_organization (organization_id) ,
    PRIMARY KEY (name, owning_organization_id)
);

CREATE TABLE mva_organization_email_addresses
(
    /* column to represent multi-valued attribute */
    email_address CHARACTER VARYING(250) ,
    /* identification of the organization this email address belongs to */
    owning_organization_id INTEGER
    REFERENCES cls_organization (organization_id) ,
    PRIMARY KEY (email_address, owning_organization_id)
);

CREATE TABLE mva_organization_phone_numbers
(
    /* column to represent multi-valued attribute */
    phone_number INTEGER
    REFERENCES cdt_phone_number (phone_number_id) ,
    /* identification of the organization this phone number belongs to */
    owning_organization_id INTEGER
    REFERENCES cls_organization (organization_id) ,
    PRIMARY KEY (phone_number, owning_organization_id)
);

CREATE TABLE cls_role
(
    /* surrogate primary key */
    role_id INTEGER PRIMARY KEY ,
    /* columns to represent attributes */
    title CHARACTER VARYING(2500) ,
    mail_address INTEGER
    REFERENCES cdt_postal_address (postal_address_id)
    /* the multi-valued attributes email_address and phone_number are */
    /* instantiated as the characteristic tables mva_role_email_addresses */
    /* and mva_role_phone_numbers */
);

CREATE TABLE mva_role_email_addresses
(
    /* column to represent multi-valued attribute */
    email_address CHARACTER VARYING(255) ,
    /* identification of the role this email address belongs to */
    owning_role_id INTEGER
    REFERENCES cls_role (role_id) ,
    PRIMARY KEY (email_address, owning_role_id)
);

CREATE TABLE mva_role_phone_numbers
(
    /* column to represent multi-valued attribute */
    phone_number INTEGER
    REFERENCES cdt_phone_number (phone_number_id) ,
    /* identification of the role this phone number belongs to */
    owning_role_id INTEGER
    REFERENCES cls_role (role_id) ,
    PRIMARY KEY (phone_number, owning_role_id)
);

```

```

CREATE TABLE cls_individual
(
  /* surrogate primary key */
  individual_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  name                   CHARACTER VARYING(255)      ,
  title                  CHARACTER VARYING(255)      ,
  mail_address           INTEGER
                        REFERENCES cdt_postal_address (postal_address_id)
  /* the multi-valued attributes email_address, phone_number and role are */
  /* instantiated as the characteristic tables mva_individual_email_addresses, */
  /* mva_individual_phone_numbers and mva_individual_roles */
);

CREATE TABLE mva_individual_email_addresses
(
  /* column to represent multi-valued attribute */
  email_address          CHARACTER VARYING(255)
  /* identification of the individual this email address belongs to */
  owning_individual_id    INTEGER
                        REFERENCES cls_individual (individual_id) ,
  PRIMARY KEY (email_address, owning_individual_id)
);

CREATE TABLE mva_individual_phone_numbers
(
  /* column to represent multi-valued attribute */
  phone_number           INTEGER
                        REFERENCES cdt_phone_number (phone_number_id) ,
  /* identification of the individual this phone number belongs to */
  owning_individual_id    INTEGER
                        REFERENCES cls_individual (individual_id) ,
  PRIMARY KEY (phone_number, owning_individual_id)
);

CREATE TABLE mva_individual_roles
(
  /* column to represent multi-valued attribute */
  role                   INTEGER
                        REFERENCES cls_role (role_id) ,
  /* identification of the individual this phone number belongs to */
  owning_individual_id    INTEGER
                        REFERENCES cls_individual (individual_id) ,
  PRIMARY KEY (role, owning_individual_id)
);

CREATE TABLE cls_contact
(
  /* surrogate primary key */
  contact_id             INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  individual              INTEGER
                        REFERENCES cls_individual (individual_id) ,
  organization            INTEGER
                        REFERENCES cls_organization (organization_id) ,
  role                   INTEGER
                        REFERENCES cls_role (role_id)
);

```

```

CREATE TABLE cls_language_identification
(
    /* surrogate primary key */
    language_identification_id          INTEGER          PRIMARY KEY ,
    /* columns to represent attributes */
    language_identifier                 CHARACTER VARYING(255) NOT NULL ,
    script_identifier                   CHARACTER VARYING(255)          ,
    region_identifier                   CHARACTER VARYING(255)          ,
    private_use_qualifier               CHARACTER VARYING(255)          ,
    /* the multi-valued attributes variant_identifiers and extension_identifiers */
    /* are instantiated as the characteristic tables */
    /* mva_language_identification_variant_identifiers and */
    /* mva_language_identification_extension_identifiers */
);

CREATE TABLE mva_language_identification_variant_identifiers
(
    /* column to represent multi-valued attribute */
    variant_identifier                 CHARACTER VARYING(255)          ,
    /* column to represent the priority of this multi-valued attribute */
    priority                           INTEGER                      ,
    /* identification of the language identification this */
    /* variant identifier belongs to */
    owning_language_identification_id  INTEGER
    REFERENCES cls_language_identification (language_identification_id) ,
    PRIMARY KEY (variant_identifier, priority, owning_language_identification_id)
);

CREATE TABLE mva_language_identification_extension_identifiers
(
    /* column to represent multi-valued attribute */
    extension_identifier               CHARACTER VARYING(255)          ,
    /* column to represent the priority of this multi-valued attribute */
    priority                           INTEGER                      ,
    /* identification of the language identification this */
    /* extension identifier belongs to */
    owning_language_identification_id  INTEGER
    REFERENCES cls_language_identification (language_identification_id) ,
    PRIMARY KEY (extension_identifier, priority, owning_language_identification_id)
);

CREATE TABLE cls_document_type
(
    /* surrogate primary key */
    document_type_id                  INTEGER          PRIMARY KEY ,
    /* columns to represent attributes */
    identifier                        CHARACTER VARYING(255)          ,
    description                       CHARACTER VARYING(255)          ,
    scheme_reference                  CHARACTER VARYING(2500)         ,
    /* constraint to check that document can be */
    /* identified or described */
    CONSTRAINT document_type_identification
    CHECK
        ( ( identifier IS NOT NULL ) OR ( description IS NOT NULL ) )
);

CREATE TABLE cls_reference_document
(
    /* surrogate primary key */
    reference_document_id             INTEGER          PRIMARY KEY ,
    /* columns to represent attributes */
    identifier                        CHARACTER VARYING(255)          ,
    document_type                     INTEGER
    REFERENCES cls_document_type (document_type_id) ,
    notation                         CHARACTER VARYING(255)          ,
    title                            CHARACTER VARYING(2500)         ,
    provider                         INTEGER
    REFERENCES cls_organization (organization_id) ,
    uri                             CHARACTER VARYING(255)
);

```

```

);

CREATE TABLE cls_registration_authority_identifier
(
  /* surrogate primary key */
  registration_authority_identifier_id
                                INTEGER                PRIMARY KEY ,
  /* columns to represent attributes */
  international_code_designator CHARACTER VARYING(255)      ,
  organization_identifier        CHARACTER VARYING(255)      ,
  organization_part_identifier    CHARACTER VARYING(255)      ,
  organization_part_identifier_source CHARACTER VARYING(255)  ,
  /* constraint to check that if the organization_part_identifier */
  /* is present, then the organization_part_identifier_source      */
  /* shall be present                                             */
  CONSTRAINT organization_part_identifier_source_presence
    CHECK
      ( ( ( organization_part_identifier is NOT NULL )
        AND ( organization_part_identifier_source IS NOT NULL ) ) OR
        ( ( organization_part_identifier is NULL )
        AND ( organization_part_identifier_source IS NULL ) ) )
);

/* ----- */
/* create tables for 11179-3 stereotypes */
/* ----- */

CREATE TABLE typ_identified_item
(
  /* surrogate primary key */
  identified_item_id
                                INTEGER                PRIMARY KEY
);

CREATE TABLE typ_registered_item
/* subclass of typ_identified_item */
(
  /* inherited surrogate primary key */
  identified_item_id
                                INTEGER                PRIMARY KEY ,
  /* foreign key to instantiate subclass */
  FOREIGN KEY (identified_item_id)
    REFERENCES typ_identified_item (identified_item_id)
);

CREATE TABLE typ_administered_item
/* subclass of typ_registered_item */
(
  /* inherited surrogate primary key */
  identified_item_id
                                INTEGER                PRIMARY KEY ,
  /* columns to represent attributes */
  version
                                CHARACTER VARYING(255)      ,
  creation_date
                                TIMESTAMP                    ,
  last_change_date
                                TIMESTAMP                    ,
  change_description
                                CHARACTER VARYING(255)      ,
  explanatory_comment
                                CHARACTER VARYING(255)      ,
  origin
                                CHARACTER VARYING(255)      ,
  /* column check constraint for enumeration of object */
  CONSTRAINT administered_item_origin_enumeration
    CHECK ( origin IN
      ( 'document' , 'project' , 'discipline' , 'model' ) ) ,
  /* foreign key to instantiate subclass */
  FOREIGN KEY (identified_item_id)
    REFERENCES typ_registered_item (identified_item_id)
);

```

```

CREATE TABLE typ_attached_item
/* subclass of typ_registered_item */
(
  /* inherited surrogate primary key */
  identified_item_id          INTEGER          PRIMARY KEY ,
  /* foreign key to instantiate subclass */
  FOREIGN KEY (identified_item_id)
    REFERENCES typ_registered_item (identified_item_id)
);

CREATE TABLE typ_classifiable_item
(
  /* surrogate primary key */
  classifiable_item_id       INTEGER          PRIMARY KEY
);

CREATE TABLE typ_designatable_item
(
  /* surrogate primary key */
  designatable_item_id       INTEGER          PRIMARY KEY
);

/* ----- */
/* create tables for other 11179-3 classes */
/* ----- */

CREATE TABLE cls_assertion
(
  /* surrogate primary key */
  assertion_id               INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  formula                    CHARACTER VARYING(255)
);

CREATE TABLE cls_binary_relation
/* subclass of cls_relation */
(
  /* inherited surrogate primary key */
  relation_id                INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  reflexivity                 CHARACTER VARYING(255) ,
  symmetry                   CHARACTER VARYING(255) ,
  transitivity               CHARACTER VARYING(255) ,
  /* column check constraint for enumeration of reflexivity */
  CONSTRAINT binary_relation_reflexivity_enumeration
    CHECK ( reflexivity IN
      ( 'reflexive' , 'irreflexive' , 'antireflexive' ) ) ,
  /* column check constraint for enumeration of symmetry */
  CONSTRAINT binary_relation_symmetry_enumeration
    CHECK ( symmetry IN
      ( 'symmetric' , 'asymmetric' , 'antisymmetric' ) ) ,
  /* column check constraint for enumeration of transitivity */
  CONSTRAINT binary_relation_transitivity_enumeration
    CHECK ( transitivity IN
      ( 'transitive' , 'intransitive' , 'antitransitive' ) )
);

CREATE TABLE cls_concept
(
  /* surrogate primary key */
  concept_id                 INTEGER          PRIMARY KEY
);

```

```

CREATE TABLE cls_concept_system
(
  /* surrogate primary key */
  concept_system_id          INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  notation                   CHARACTER VARYING(255)
);

CREATE TABLE cls_conceptual_domain
(
  /* surrogate primary key */
  conceptual_domain_id       INTEGER          PRIMARY KEY
  /* the column and foreign key for the dimensionality attribute */
  /* is added using alter table statements */
);

CREATE TABLE cls_context
(
  /* surrogate primary key */
  context_id                INTEGER          PRIMARY KEY
);

CREATE TABLE cls_data_element
(
  /* surrogate primary key */
  data_element_id           INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  precision                 INTEGER
);

CREATE TABLE cls_data_element_concept
(
  /* surrogate primary key */
  data_element_concept_id   INTEGER          PRIMARY KEY
);

CREATE TABLE cls_data_element_derivation
(
  /* surrogate primary key */
  data_element_derivation_id INTEGER          PRIMARY KEY
);

CREATE TABLE cls_data_element_example
(
  /* surrogate primary key */
  data_element_example_id   INTEGER          PRIMARY KEY
  /* the multi-valued attribute example_item is instantiated */
  /* as the characteristic table mva_data_element_example_items */
);

CREATE TABLE mva_data_element_example_items
(
  /* column to represent multi-valued attribute */
  example_item              CHARACTER VARYING(2500) ,
  /* identification of the data element example this */
  /* example item belongs to */
  owning_data_element_example_id INTEGER
  REFERENCES cls_data_element_example_id (data_element_example_id) ,
  PRIMARY KEY (example_item, owning_data_element_example_id)
);

```

```

CREATE TABLE cls_datatype
(
  /* surrogate primary key */
  datatype_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  name                 CHARACTER VARYING(255)      ,
  description          CHARACTER VARYING(2500)     ,
  annotation           CHARACTER VARYING(2500)
  /* the column and foreign key for the scheme reference attribute */
  /* are added using alter table statements */
);

CREATE TABLE cls_definition
(
  /* surrogate primary key */
  definition_id        INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  text                 CHARACTER VARYING(2500)
  /* the columns and foreign keys for the language and source attributes */
  /* are added using alter table statements */
);

CREATE TABLE cls_derivation_rule
(
  /* surrogate primary key */
  derivation_rule_id   INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  specification        CHARACTER VARYING(2500)     ,
  notation             CHARACTER VARYING(255)
);

CREATE TABLE cls_described_conceptual_domain
/* subclass of cls_conceptual_domain */
(
  /* inherited surrogate primary key */
  conceptual_domain_id INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  description          CHARACTER VARYING(2500)
);

CREATE TABLE cls_described_value_domain
/* subclass of cls_value_domain */
(
  /* inherited surrogate primary key */
  value_domain_id      INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  description           CHARACTER VARYING(2500)
);

CREATE TABLE cls_designation
(
  /* surrogate primary key */
  designation_id       INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  sign                 CHARACTER VARYING(2500)
);

CREATE TABLE cls_dimensionality
(
  /* surrogate primary key */
  dimensionality_id    INTEGER          PRIMARY KEY ,
  /* columns to represent native attributes */
  coordinate_indicator  BOOLEAN
);

```

```

CREATE TABLE cls_enumerated_conceptual_domain
/* subclass of cls_conceptual_domain */
(
  /* inherited surrogate primary key */
  conceptual_domain_id          INTEGER          PRIMARY KEY
);

CREATE TABLE cls_enumerated_value_domain
/* subclass of cls_value_domain */
(
  /* inherited surrogate primary key */
  value_domain_id              INTEGER          PRIMARY KEY
);

CREATE TABLE cls_link
/* subclass of cls_assertion */
(
  /* inherited surrogate primary key */
  assertion_id                 INTEGER          PRIMARY KEY
);

CREATE TABLE cls_link_end
(
  /* surrogate primary key */
  link_end_id                  INTEGER          PRIMARY KEY
);

CREATE TABLE cls_measure_class
(
  /* surrogate primary key */
  measure_class_id             INTEGER          PRIMARY KEY
);

CREATE TABLE cls_namespace
(
  /* surrogate primary key */
  namespace_id                 INTEGER          PRIMARY KEY ,
  /* columns to represent native attributes */
  one_name_per_item_indicator   BOOLEAN        ,
  one_item_per_name_indicator   BOOLEAN        ,
  mandatory_naming_convention_indicator   BOOLEAN        ,
  shorthand_prefix              CHARACTER VARYING(255) ,
  scheme_reference              CHARACTER VARYING(2500) ,
  /* the column and foreign key for the naming_authority attribute */
  /* are added using alter table statements */
);

CREATE TABLE cls_naming_convention
(
  /* surrogate primary key */
  naming_convention_id         INTEGER          PRIMARY KEY ,
  /* columns to represent native attributes */
  scope_rule                   CHARACTER VARYING(2500) ,
  authority_rule                CHARACTER VARYING(2500) ,
  semantic_rule                 CHARACTER VARYING(2500) ,
  syntactic_rule                CHARACTER VARYING(2500) ,
  lexical_rule                  CHARACTER VARYING(2500)
);

CREATE TABLE cls_object_class
(
  /* surrogate primary key */
  object_class_id              INTEGER          PRIMARY KEY
);

```

```

CREATE TABLE cls_permmissible_value
(
  /* surrogate primary key */
  permissible_value_id          INTEGER          PRIMARY KEY ,
  /* the permitted_value attribute has datatype 'value' which can be of any */
  /* datatype - this is instantiated by a different column for each datatype */
  /* and a check constraint to ensure that only one 'datatype' has a value */
  boolean_permitted_value      BOOLEAN          ,
  date_permitted_value         DATE              ,
  datetime_permitted_value     TIMESTAMP        ,
  integer_permitted_value      INTEGER          ,
  lower_bound_natural_range_permitted_value     INTEGER          ,
  fixed_upper_bound_natural_range_permitted_value INTEGER          ,
  many_upper_bound_natural_range_permitted_value CHARACTER(4)    DEFAULT 'many' ,
  notation_permitted_value     CHARACTER VARYING(2500) ,
  phone_number_permitted_value INTEGER          ,
  postal_address_permitted_value INTEGER          REFERENCES cdt_phone_number (phone_number_id) ,
  sign_permitted_value         CHARACTER VARYING(2500) ,
  string_permitted_value       CHARACTER VARYING(255)  ,
  text_permitted_value         CHARACTER VARYING(2500) ,
  /* columns to represent other attributes */
  begin_date                   DATE              ,
  end_date                     DATE              ,
  /* Check constraint to manage datatype columns */
  CONSTRAINT datatype_of_permitted_value
    CHECK
      ( ( ( boolean_permitted_value IS NOT NULL )
        AND ( date_permitted_value IS NULL )
        AND ( datetime_permitted_value IS NULL )
        AND ( integer_permitted_value IS NULL )
        AND ( lower_bound_natural_range_permitted_value IS NULL )
        AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
        AND ( many_upper_bound_natural_range_permitted_value IS NULL )
        AND ( phone_number_permitted_value IS NULL )
        AND ( postal_address_permitted_value IS NULL )
        AND ( sign_permitted_value IS NULL )
        AND ( string_permitted_value IS NULL )
        AND ( text_permitted_value IS NULL ) )
      OR
        ( ( boolean_permitted_value IS NULL )
        AND ( date_permitted_value IS NOT NULL )
        AND ( datetime_permitted_value IS NULL )
        AND ( integer_permitted_value IS NULL )
        AND ( lower_bound_natural_range_permitted_value IS NULL )
        AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
        AND ( many_upper_bound_natural_range_permitted_value IS NULL )
        AND ( phone_number_permitted_value IS NULL )
        AND ( postal_address_permitted_value IS NULL )
        AND ( sign_permitted_value IS NULL )
        AND ( string_permitted_value IS NULL )
        AND ( text_permitted_value IS NULL ) )
      OR
        ( ( boolean_permitted_value IS NULL )
        AND ( date_permitted_value IS NULL )
        AND ( datetime_permitted_value IS NOT NULL )
        AND ( integer_permitted_value IS NULL )
        AND ( lower_bound_natural_range_permitted_value IS NULL )
        AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
        AND ( many_upper_bound_natural_range_permitted_value IS NULL )
        AND ( phone_number_permitted_value IS NULL )
        AND ( postal_address_permitted_value IS NULL )
        AND ( sign_permitted_value IS NULL )
        AND ( string_permitted_value IS NULL )
        AND ( text_permitted_value IS NULL ) ) )

```



```

        AND ( many_upper_bound_natural_range_permitted_value IS NULL )
        AND ( phone_number_permitted_value IS NULL )
        AND ( postal_address_permitted_value IS NOT NULL )
        AND ( sign_permitted_value IS NULL )
        AND ( string_permitted_value IS NULL )
        AND ( text_permitted_value IS NULL ) )
    OR
    ( ( boolean_permitted_value IS NULL )
      AND ( date_permitted_value IS NULL )
      AND ( datetime_permitted_value IS NULL )
      AND ( integer_permitted_value IS NULL )
      AND ( lower_bound_natural_range_permitted_value IS NULL )
      AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
      AND ( many_upper_bound_natural_range_permitted_value IS NULL )
      AND ( phone_number_permitted_value IS NULL )
      AND ( postal_address_permitted_value IS NULL )
      AND ( sign_permitted_value IS NOT NULL )
      AND ( string_permitted_value IS NULL )
      AND ( text_permitted_value IS NULL ) )
    OR
    ( ( boolean_permitted_value IS NULL )
      AND ( date_permitted_value IS NULL )
      AND ( datetime_permitted_value IS NULL )
      AND ( integer_permitted_value IS NULL )
      AND ( lower_bound_natural_range_permitted_value IS NULL )
      AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
      AND ( many_upper_bound_natural_range_permitted_value IS NULL )
      AND ( phone_number_permitted_value IS NULL )
      AND ( postal_address_permitted_value IS NULL )
      AND ( sign_permitted_value IS NULL )
      AND ( string_permitted_value IS NOT NULL )
      AND ( text_permitted_value IS NULL ) )
    OR
    ( ( boolean_permitted_value IS NULL )
      AND ( date_permitted_value IS NULL )
      AND ( datetime_permitted_value IS NULL )
      AND ( integer_permitted_value IS NULL )
      AND ( lower_bound_natural_range_permitted_value IS NULL )
      AND ( fixed_upper_bound_natural_range_permitted_value IS NULL )
      AND ( many_upper_bound_natural_range_permitted_value IS NULL )
      AND ( phone_number_permitted_value IS NULL )
      AND ( postal_address_permitted_value IS NULL )
      AND ( sign_permitted_value IS NULL )
      AND ( string_permitted_value IS NULL )
      AND ( text_permitted_value IS NOT NULL ) ) )
CONSTRAINT permissible_value_cannot_have_an_end_date_without_a_begin_date
CHECK
    ( ( ( begin_date IS NULL ) AND ( end_date IS NULL ) OR
      ( ( begin_date IS NOT NULL ) AND ( end_date IS NULL ) OR
      ( ( begin_date IS NOT NULL ) AND ( end_date IS NOT NULL ) ) ) )
);

CREATE TABLE cls_property
(
    /* surrogate primary key */
    property_id                INTEGER                PRIMARY KEY
);

CREATE TABLE cls_registrar
/* subclass of contact */
(
    /* inherited surrogate primary key */
    contact_id                INTEGER                PRIMARY KEY ,
    /* columns to represent native attributes */
    identifier                 CHARACTER VARYING(255) NOT NULL ,
);

```

```

CREATE TABLE cls_registration_authority
/* subclass of cls_organization */
(
  /* inherited surrogate primary key */
  organization_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  registration_authority_identifier  INTEGER          UNIQUE
      REFERENCES cls_registration_authority_identifier
      (registration_authority_identifier_id) ,
  document_language_identifier  INTEGER
      REFERENCES cls_language_identification
      (language_identification_id)
);

CREATE TABLE cls_registration_state
(
  /* surrogate primary key */
  registration_state_id      INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  registration_status        CHARACTER VARYING(255) ,
  effective_date             TIMESTAMP ,
  until_date                 TIMESTAMP ,
  administrative_note        CHARACTER VARYING(2500) ,
  unresolved_issue          CHARACTER VARYING(2500) ,
  administrative_status      CHARACTER VARYING(255) ,
  previous_state             INTEGER          UNIQUE
      REFERENCES cls_registration_state (registration_state_id)
  /* this reflexive association to registration is one-to-one */
);

CREATE TABLE cls_registry_specification
(
  /* surrogate primary key */
  registry_specification_id  INTEGER          PRIMARY KEY ,
  /* columns to represent native attributes */
  name                      CHARACTER VARYING(2500) ,
  web_address               CHARACTER VARYING(255) ,
  standard                  CHARACTER VARYING(255) ,
  conformance_level         CHARACTER VARYING(255) ,
  character_repertoire       CHARACTER VARYING(255) ,
  reference_document_identifier_form  CHARACTER VARYING(255) ,
  primary_language          INTEGER
      REFERENCES cls_language_identification
      (language_identification_id) ,
  /* the column and foreign keys for the representation_class_scheme */
  /* and context attributes are added using alter table statements */
  comment                   CHARACTER VARYING(2500)
);

```

```

CREATE TABLE cls_relation
/* subclass of cls_concept */
(
  /* surrogate primary key */
  relation_id                INTEGER                PRIMARY KEY ,
  /* columns to represent attribute with natural range datatype*/
  arity_lower_bound_natural_range    INTEGER                ,
  arity_fixed_upper_bound_natural_range    INTEGER                ,
  arity_many_upper_bound_natural_range    CHARACTER(4)    DEFAULT 'many' ,
  CONSTRAINT relation_arity_natural_range_check
  CHECK
    ( ( ( arity_lower_bound_natural_range IS NULL )
      AND ( arity_fixed_upper_bound_natural_range IS NULL )
      AND ( arity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( arity_lower_bound_natural_range IS NOT NULL )
      AND ( arity_fixed_upper_bound_natural_range IS NULL )
      AND ( arity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( arity_lower_bound_natural_range IS NOT NULL )
      AND ( arity_fixed_upper_bound_natural_range IS NOT NULL )
      AND ( arity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( arity_lower_bound_natural_range IS NOT NULL )
      AND ( arity_fixed_upper_bound_natural_range IS NULL )
      AND ( arity_many_upper_bound_natural_range IS NOT NULL ) ) )
);

CREATE TABLE cls_relation_role
/* subclass of cls_concept */
(
  /* surrogate primary key */
  relation_role_id            INTEGER                PRIMARY KEY ,
  /* columns to represent attributes */
  multiplicity_lower_bound_natural_range    INTEGER                ,
  multiplicity_fixed_upper_bound_natural_range    INTEGER                ,
  multiplicity_many_upper_bound_natural_range    INTEGER                ,
  ordinal                        CHARACTER(4)    DEFAULT 'many' ,
  CONSTRAINT relation_role_multiplicity_natural_range_check
  CHECK
    ( ( ( multiplicity_lower_bound_natural_range IS NULL )
      AND ( multiplicity_fixed_upper_bound_natural_range IS NULL )
      AND ( multiplicity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( multiplicity_lower_bound_natural_range IS NOT NULL )
      AND ( multiplicity_fixed_upper_bound_natural_range IS NULL )
      AND ( multiplicity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( multiplicity_lower_bound_natural_range IS NOT NULL )
      AND ( multiplicity_fixed_upper_bound_natural_range IS NOT NULL )
      AND ( multiplicity_many_upper_bound_natural_range IS NULL ) )
    OR
      ( ( multiplicity_lower_bound_natural_range IS NOT NULL )
      AND ( multiplicity_fixed_upper_bound_natural_range IS NULL )
      AND ( multiplicity_many_upper_bound_natural_range IS NOT NULL ) ) )
);

```

```

CREATE TABLE cls_scoped_identifier
(
  /* surrogate primary key */
  scoped_identifier_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  identifier                    CHARACTER VARYING(255)      ,
  full_expansion                CHARACTER VARYING(255)      ,
  short_expansion               CHARACTER VARYING(255)
);

CREATE TABLE cls_slot
(
  /* surrogate primary key */
  slot_id                      INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  name                         CHARACTER VARYING(255)      ,
  type                         CHARACTER VARYING(255)
  /* the multi-valued attribute value is instantiated */
  /* as the characteristic table mva_slot_values */
);

CREATE TABLE mva_slot_values
(
  /* column to represent multi-valued attribute */
  Value                        CHARACTER VARYING(255)      ,
  /* column to represent the priority of this multi-valued attribute */
  priority                     INTEGER              ,
  /* identification of the slot this value belongs to */
  owning_slot_id              INTEGER              ,
                                REFERENCES cls_slot (slot_id) ,
  PRIMARY KEY (value, priority, owning_slot_id)
);

CREATE TABLE cls_stewardship_record
(
  /* surrogate primary key */
  stewardship_record_id        INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  organization                  INTEGER          ,
                                REFERENCES cls_organization (organization_id) ,
  contact                       INTEGER          ,
                                REFERENCES cls_contact (contact_id)
);

CREATE TABLE cls_submission_record
(
  /* surrogate primary key */
  submission_record_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  organization                  INTEGER          ,
                                REFERENCES cls_organization (organization_id) ,
  contact                       INTEGER          ,
                                REFERENCES cls_contact (contact_id)
);

CREATE TABLE cls_unit_of_measure
(
  /* surrogate primary key */
  unit_of_measure_id            INTEGER          PRIMARY KEY
);

```

```

CREATE TABLE cls_value_domain
(
  /* surrogate primary key */
  value_domain_id          INTEGER          PRIMARY KEY ,
  /* columns to represent attributes */
  /* the column and foreign key for the datatype */
  /* attribute are added using alter table statements */
  format                   CHARACTER VARYING(255) ,
  maximum_character_quantity INTEGER
  /* the column and foreign key for the unit_of_measure */
  /* attribute are added using alter table statements */
);

CREATE TABLE cls_value_meaning
(
  /* surrogate primary key */
  value_meaning_id          INTEGER          PRIMARY KEY ,
  /* columns to represent native attributes */
  begin_date               DATE ,
  end_date                 DATE ,
  CONSTRAINT value_meaning_cannot_have_an_end_date_without_a_begin_date
  CHECK
    ( ( ( begin_date IS NULL ) AND ( end_date IS NULL ) OR
      ( ( begin_date IS NOT NULL ) AND ( end_date IS NULL ) OR
      ( ( begin_date IS NOT NULL ) AND ( end_date IS NOT NULL ) ) )
);

/* ----- */
/* create tables (and alter table statements) to instantiate the 11179-3 */
/* association classes */
/* ----- */

CREATE TABLE asscls_classification
(
  /* surrogate primary key */
  classification_id          INTEGER          PRIMARY KEY ,
  /* columns and foreign keys for roles of the association class */
  classifier                INTEGER          ,
  classified_item            INTEGER          ,
  CONSTRAINT classifications_have_classifiers
  FOREIGN KEY (classifier)
  REFERENCES cls_concept (concept_id) ,
  CONSTRAINT classifications_have_classified_items
  FOREIGN KEY (classified_item)
  REFERENCES typ_classifiable_item (classifiable_item_id) ,
);

CREATE TABLE asscls_definition_context
(
  definition_context_id      INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  acceptability              CHARACTER VARYING(255) ,
  /* columns and foreign keys for roles of the association class */
  relevant_definition        INTEGER          ,
  scope                     INTEGER          ,
  CONSTRAINT definition_contexts_have_relevant_definitions
  FOREIGN KEY (relevant_definition)
  REFERENCES cls_definition (definition_id) ,
  CONSTRAINT definition_contexts_have_scopes
  FOREIGN KEY (scope)
  REFERENCES cls_context (context_id) ,
  /* column check constraint for enumeration of */
  /* definition_acceptability */
  CONSTRAINT definition_context_acceptability_enumeration
  CHECK ( acceptability IN
    ( 'preferred' , 'admitted' , 'deprecated' ,
      'obsolete' , 'superseded' ) )
);

```

```

CREATE TABLE asscls_designation_context
(
  /* surrogate primary key */
  designation_context_id          INTEGER          PRIMARY KEY ,
  /* column to represent attribute */
  acceptability                   CHARACTER VARYING(255)      ,
  /* columns and foreign keys for roles of the association class */
  relevant_definition             INTEGER            ,
  scope                           INTEGER            ,
  CONSTRAINT designation_contexts_have_relevant_definitions
    FOREIGN KEY (relevant_definition)
      REFERENCES cls_definition (definition_id)            ,
  CONSTRAINT designation_contexts_have_scopes
    FOREIGN KEY (scope)
      REFERENCES cls_context (context_id)                  ,
  /* column check constraint for enumeration of */
  /* designation_acceptability */
  CONSTRAINT designation_context_acceptability_enumeration
    CHECK ( acceptability IN
      ( 'preferred' , 'admitted' , 'deprecated' ,
        'obsolete' , 'superseded' ) )
);

CREATE TABLE asscls_reference
(
  /* surrogate primary key */
  reference_id                    INTEGER            PRIMARY KEY ,
  /* column to represent attribute */
  reference_type                  CHARACTER VARYING(255)      ,
  /* columns and foreign keys for roles of the association class */
  linked_reference_document       INTEGER            ,
  linked_registered_item          INTEGER            ,
  CONSTRAINT references_have_linked_reference_documents
    FOREIGN KEY (linked_reference_document)
      REFERENCES cls_reference_document (reference_document_id) ,
  CONSTRAINT references_have_linked_registered_items
    FOREIGN KEY (linked_registered_item)
      REFERENCES typ_registered_item (identified_item_id)
);

CREATE TABLE asscls_registration
(
  /* surrogate primary key */
  registration_id                 INTEGER            PRIMARY KEY ,
  /* the column and foreign key for the registration_state attribute */
  /* are added using alter table statements */
);

/* ----- */
/* add columns and foreign keys to the tables for 11179-3 classes and */
/* subclasses for 'missing' attributes */
/* ----- */

/* ----- */
/* add column and foreign key to cls_conceptual_domain */
/* to represent the dimensionality attribute */
/* ----- */

ALTER TABLE cls_conceptual_domain
  ADD COLUMN
    dimensionality                INTEGER
;

ALTER TABLE cls_conceptual_domain
  ADD CONSTRAINT conceptual_domains_have_dimensionalities
    FOREIGN KEY (dimensionality)
      REFERENCES cls_dimensionality (dimensionality_id);

```

```

/* ----- */
/* add column and foreign key to cls_datatype */
/* to represent the scheme_reference attribute */
/* ----- */

ALTER TABLE cls_datatype
  ADD COLUMN
    scheme_reference          INTEGER
  ;

ALTER TABLE cls_datatype
  ADD CONSTRAINT datatypes_have_scheme_references
    FOREIGN KEY (scheme_reference)
      REFERENCES cls_reference_document (reference_document_id);

/* ----- */
/* add column and foreign key to cls_definition */
/* to represent the language attribute */
/* ----- */

ALTER TABLE cls_definition
  ADD COLUMN
    language                  INTEGER
  ;

ALTER TABLE cls_definition
  ADD CONSTRAINT definitions_have_languages
    FOREIGN KEY (language)
      REFERENCES cls_language_identification (language_identification_id);

/* ----- */
/* add column and foreign key to cls_definition */
/* to represent the source attribute */
/* ----- */

ALTER TABLE cls_definition
  ADD COLUMN
    source                    INTEGER
  ;

ALTER TABLE cls_definition
  ADD CONSTRAINT definitions_have_sources
    FOREIGN KEY (source)
      REFERENCES cls_reference_document (reference_document_id);

/* ----- */
/* add column and foreign key to cls_namespace */
/* to represent the naming_authority attribute */
/* ----- */

ALTER TABLE cls_namespace
  ADD COLUMN
    naming_authority          INTEGER
  ;

ALTER TABLE cls_namespace
  ADD CONSTRAINT namespaces_have_naming_authorities
    FOREIGN KEY (naming_authority)
      REFERENCES cls_organization (organization_id);

/* ----- */
/* add column and foreign key to cls_registry_specification */
/* to represent the representation_class_scheme attribute */
/* ----- */

ALTER TABLE cls_registry_specification
  ADD COLUMN
    representation_class_scheme  INTEGER          UNIQUE
  ;

```

```

ALTER TABLE cls_registry_specification
  ADD CONSTRAINT registry_specifications_have_representation_class_schemes
    FOREIGN KEY (representation_class_scheme)
      REFERENCES cls_concept_system (concept_system_id);

/* ----- */
/* add column and foreign key to cls_registry_specification */
/* to represent the context attribute */
/* ----- */

ALTER TABLE cls_registry_specification
  ADD COLUMN
    context                                INTEGER          UNIQUE
    ;

ALTER TABLE cls_registry_specification
  ADD CONSTRAINT registry_specifications_have_contexts
    FOREIGN KEY (context)
      REFERENCES cls_context (context_id);

/* ----- */
/* add column and foreign key to cls_value_domain */
/* to represent the datatype attribute */
/* ----- */

ALTER TABLE cls_value_domain
  ADD COLUMN
    datatype                                INTEGER
    ;

ALTER TABLE cls_value_domain
  ADD CONSTRAINT value_domains_have_datatypes
    FOREIGN KEY (datatype)
      REFERENCES cls_datatype (datatype_id);

/* ----- */
/* add column and foreign key to cls_value_domain */
/* to represent the unit_of_measure attribute */
/* ----- */

ALTER TABLE cls_value_domain
  ADD COLUMN
    unit_of_measure                        INTEGER
    ;

ALTER TABLE cls_value_domain
  ADD CONSTRAINT value_domains_have_unit_of_measures
    FOREIGN KEY (unit_of_measure)
      REFERENCES cls_unit_of_measure (unit_of_measure_id);

/* ----- */
/* add column and foreign key to asscls_registration */
/* to represent the registration_state attribute */
/* ----- */

ALTER TABLE asscls_registration
  ADD COLUMN
    registration_state                    INTEGER          UNIQUE
    ;

ALTER TABLE asscls_registration
  ADD CONSTRAINT registrations_have_registration_states
    FOREIGN KEY (registration_state)
      REFERENCES cls_registration_state (registration_state_id);

/* ----- */
/* add columns and foreign keys to the tables for 11179-3 */
/* classes to instantiate subclassing where appropriate */
/* ----- */

```

```

/* ----- */
/* add column and foreign key to cls_binary_relation because */
/* cls_binary_relation is a subclass of cls_relation */
/* ----- */

ALTER TABLE cls_binary_relation
  ADD COLUMN
    superclass_relation_id          INTEGER          NOT NULL    UNIQUE
  ;

ALTER TABLE cls_binary_relation
  ADD CONSTRAINT binary_relation_is_a_subclass_of_relation
    FOREIGN KEY (superclass_relation_id)
      REFERENCES cls_relation (relation_id);

/* ----- */
/* add column and foreign key to cls_conceptual_domain because */
/* cls_conceptual_domain is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_conceptual_domain
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
  ;

ALTER TABLE cls_conceptual_domain
  ADD CONSTRAINT conceptual_domain_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add column and foreign key to cls_data_element_concept because */
/* cls_data_element_concept is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_data_element_concept
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
  ;

ALTER TABLE cls_data_element_concept
  ADD CONSTRAINT data_element_concept_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add foreign key to cls_described_conceptual_domain because */
/* cls_described_conceptual_domain is a subclass of cls_conceptual_domain */
/* ----- */

ALTER TABLE cls_described_conceptual_domain
  ADD CONSTRAINT described_conceptual_domain_is_a_subclass_of_conceptual_domain
    FOREIGN KEY (conceptual_domain_id)
      REFERENCES cls_conceptual_domain (conceptual_domain_id);

/* ----- */
/* add foreign key to cls_described_value_domain because */
/* cls_described_value_domain is a subclass of cls_value_domain */
/* ----- */

ALTER TABLE cls_described_value_domain
  ADD CONSTRAINT described_value_domain_is_a_subclass_of_value_domain
    FOREIGN KEY (value_domain_id)
      REFERENCES cls_value_domain (value_domain_id);

/* ----- */
/* add column and foreign key to cls_dimensionality because */
/* cls_dimensionality is a subclass of cls_concept */
/* ----- */

```

```

ALTER TABLE cls_dimensionality
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_dimensionality
  ADD CONSTRAINT dimensionality_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add foreign key to cls_enumerated_conceptual_domain because */
/* cls_enumerated_conceptual_domain is a subclass of cls_conceptual_domain */
/* ----- */

ALTER TABLE cls_enumerated_conceptual_domain
  ADD CONSTRAINT enumerated_conceptual_domain_is_a_subclass_of_conceptual_domain
    FOREIGN KEY (conceptual_domain_id)
      REFERENCES cls_conceptual_domain (conceptual_domain_id);

/* ----- */
/* add foreign key to cls_enumerated_value_domain because */
/* cls_enumerated_value_domain is a subclass of cls_value_domain */
/* ----- */

ALTER TABLE cls_enumerated_value_domain
  ADD CONSTRAINT enumerated_value_domain_is_a_subclass_of_value_domain
    FOREIGN KEY (value_domain_id)
      REFERENCES cls_value_domain (value_domain_id);

/* ----- */
/* add foreign key to cls_link because */
/* cls_link is a subclass of cls_assertion */
/* ----- */

ALTER TABLE cls_link
  ADD CONSTRAINT link_is_a_subclass_of_assertion
    FOREIGN KEY (assertion_id)
      REFERENCES cls_assertion (assertion_id);

/* ----- */
/* add column and foreign key to cls_object_class because */
/* cls_object_class is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_object_class
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_object_class
  ADD CONSTRAINT object_class_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add column and foreign key to cls_property because */
/* cls_property is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_property
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_property
  ADD CONSTRAINT property_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

```

```

/* ----- */
/* add foreign key to cls_registrar because */
/* cls_registrar is a subclass of cls_contact */
/* ----- */

ALTER TABLE cls_registrar
  ADD CONSTRAINT registrar_is_a_subclass_of_contact
    FOREIGN KEY (contact_id)
      REFERENCES cls_contact (contact_id);

/* ----- */
/* add column and foreign key to cls_relation because */
/* cls_relation is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_relation
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_relation
  ADD CONSTRAINT relation_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add column and foreign key to cls_relation_role because */
/* cls_relation_role is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_relation_role
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_relation_role
  ADD CONSTRAINT relation_role_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add column and foreign key to cls_unit_of_measure because */
/* cls_unit_of_measure is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_unit_of_measure
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_unit_of_measure
  ADD CONSTRAINT unit_of_measure_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

/* ----- */
/* add column and foreign key to cls_value_meaning because */
/* cls_value_meaning is a subclass of cls_concept */
/* ----- */

ALTER TABLE cls_value_meaning
  ADD COLUMN
    superclass_concept_id          INTEGER          NOT NULL    UNIQUE
    ;

ALTER TABLE cls_value_meaning
  ADD CONSTRAINT value_meaning_is_a_subclass_of_concept
    FOREIGN KEY (superclass_concept_id)
      REFERENCES cls_concept (concept_id);

```

```

/* ----- */
/* add columns and foreign keys to the tables for 11179-3 classes */
/* because metadata items can be identified, classified and designated */
/* ----- */

/* ----- */
/* add columns and foreign keys to cls_assertion because assertions */
/* can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_assertion
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_assertion
  ADD COLUMN
    (
      linked_classifiable_item_id      INTEGER          UNIQUE
    );

ALTER TABLE cls_assertion
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_assertion
  ADD CONSTRAINT each_assertion_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_assertion
  ADD CONSTRAINT each_assertion_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_assertion
  ADD CONSTRAINT each_assertion_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to asscls_classification because */
/* classifications can be identified, classified and designated */
/* ----- */

ALTER TABLE asscls_classification
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE asscls_classification
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE asscls_classification
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE asscls_classification
  ADD CONSTRAINT each_classification_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE asscls_classification
  ADD CONSTRAINT each_classification_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE asscls_classification
  ADD CONSTRAINT each_classification_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_concept because concepts */
/* can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_concept
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept
  ADD CONSTRAINT each_concept_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_concept
  ADD CONSTRAINT each_concept_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_concept
  ADD CONSTRAINT each_concept_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_concept_system because concept */
/* systems can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_concept_system
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept_system
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept_system
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_concept_system
  ADD CONSTRAINT each_concept_system_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_concept_system
  ADD CONSTRAINT each_concept_system_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_concept_system
  ADD CONSTRAINT each_concept_system_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_conceptual_domain because */
/* conceptual domains can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_conceptual_domain
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_conceptual_domain
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_conceptual_domain
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_conceptual_domain
  ADD CONSTRAINT each_conceptual_domain_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_described_conceptual_domain
  ADD CONSTRAINT each_conceptual_domain_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_described_conceptual_domain
  ADD CONSTRAINT each_conceptual_domain_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_context because */
/* contexts can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_context
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_context
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_context
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_context
  ADD CONSTRAINT each_context_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_context
  ADD CONSTRAINT each_context_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_context
  ADD CONSTRAINT each_context_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_data_element because */
/* data elements can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_data_element
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element
  ADD CONSTRAINT each_data_element_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_data_element
  ADD CONSTRAINT each_data_element_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_data_element
  ADD CONSTRAINT each_data_element_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_data_element_concept because */
/* data element concepts can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_data_element_concept
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_concept
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_concept
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_concept
  ADD CONSTRAINT each_data_element_concept_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_data_element_concept
  ADD CONSTRAINT each_data_element_concept_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_data_element_concept
  ADD CONSTRAINT each_data_element_concept_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_data_element_derivation because */
/* data element derivations can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_data_element_derivation
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_derivation
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_derivation
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_derivation
  ADD CONSTRAINT each_data_element_derivation_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_data_element_derivation
  ADD CONSTRAINT each_data_element_derivation_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_data_element_derivation
  ADD CONSTRAINT each_data_element_derivation_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_data_element_example because */
/* data element examples can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_data_element_example
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_example
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_example
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_data_element_example
  ADD CONSTRAINT each_data_element_example_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_data_element_example
  ADD CONSTRAINT each_data_element_example_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_data_element_example
  ADD CONSTRAINT each_data_element_example_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_datatype because */
/* datatypes can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_datatype
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_datatype
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_datatype
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_datatype
  ADD CONSTRAINT each_datatype_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_datatype
  ADD CONSTRAINT each_datatype_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_datatype
  ADD CONSTRAINT each_datatype_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_derivation_rule because */
/* derivation rules can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_derivation_rule
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_derivation_rule
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_derivation_rule
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_derivation_rule
  ADD CONSTRAINT each_derivation_rule_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_derivation_rule
  ADD CONSTRAINT each_derivation_rule_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_derivation_rule
  ADD CONSTRAINT each_derivation_rule_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_dimensionality because */
/* dimensionalities can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_dimensionality
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_dimensionality
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_dimensionality
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_dimensionality
  ADD CONSTRAINT each_dimensionality_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_dimensionality
  ADD CONSTRAINT each_dimensionality_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_dimensionality
  ADD CONSTRAINT each_dimensionality_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_link_end because */
/* link ends can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_link_end
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_link_end
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_link_end
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_link_end
  ADD CONSTRAINT each_link_end_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_link_end
  ADD CONSTRAINT each_link_end_may_be_classified
  FOREIGN KEY (linked_classifiable_item_id)
  REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_link_end
  ADD CONSTRAINT each_link_end_may_be_designated
  FOREIGN KEY (linked_designatable_item_id)
  REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_namespace because */
/* namespaces can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_namespace
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_namespace
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_namespace
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_namespace
  ADD CONSTRAINT each_namespace_may_be_identified
  FOREIGN KEY (linked_identified_item_id)
  REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_namespace
  ADD CONSTRAINT each_namespace_may_be_classified
  FOREIGN KEY (linked_classifiable_item_id)
  REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_namespace
  ADD CONSTRAINT each_namespace_may_be_designated
  FOREIGN KEY (linked_designatable_item_id)
  REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_naming_convention because */
/* naming conventions can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_naming_convention
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_naming_convention
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_naming_convention
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_naming_convention
  ADD CONSTRAINT each_naming_convention_may_be_identified
  FOREIGN KEY (linked_identified_item_id)
  REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_naming_convention
  ADD CONSTRAINT each_naming_convention_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_naming_convention
  ADD CONSTRAINT each_naming_convention_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_permmissible_value because */
/* permmissible values can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_permmissible_value
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_permmissible_value
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_permmissible_value
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_permmissible_value
  ADD CONSTRAINT each_permmissible_value_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_permmissible_value
  ADD CONSTRAINT each_permmissible_value_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_permmissible_value
  ADD CONSTRAINT each_permmissible_value_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_unit_of_measure because */
/* units of measure can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_unit_of_measure
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_unit_of_measure
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_unit_of_measure
  ADD COLUMN
    linked_designatable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_unit_of_measure
  ADD CONSTRAINT each_unit_of_measure_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_unit_of_measure
  ADD CONSTRAINT each_unit_of_measure_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_unit_of_measure
  ADD CONSTRAINT each_unit_of_measure_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_value_domain because */
/* value domains can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_value_domain
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_domain
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_domain
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_domain
  ADD CONSTRAINT each_value_domain_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

ALTER TABLE cls_value_domain
  ADD CONSTRAINT each_value_domain_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_value_domain
  ADD CONSTRAINT each_value_domain_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* add columns and foreign keys to cls_value_meaning because */
/* value meanings can be identified, classified and designated */
/* ----- */

ALTER TABLE cls_value_meaning
  ADD COLUMN
    linked_identified_item_id          INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_meaning
  ADD COLUMN
    linked_classifiable_item_id        INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_meaning
  ADD COLUMN
    linked_designatable_item_id         INTEGER          UNIQUE
  ;

ALTER TABLE cls_value_meaning
  ADD CONSTRAINT each_value_meaning_may_be_identified
    FOREIGN KEY (linked_identified_item_id)
      REFERENCES typ_identified_item (identified_item_id);

```

```

ALTER TABLE cls_value_meaning
  ADD CONSTRAINT each_value_meaning_may_be_classified
    FOREIGN KEY (linked_classifiable_item_id)
      REFERENCES typ_classifiable_item (classifiable_item_id);

ALTER TABLE cls_value_meaning
  ADD CONSTRAINT each_value_meaning_may_be_designated
    FOREIGN KEY (linked_designatable_item_id)
      REFERENCES typ_designatable_item (designatable_item_id);

/* ----- */
/* create tables for the 11179-3 associations */
/* ----- */

CREATE TABLE ass_assertion_inclusion
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  assertor          INTEGER
                    REFERENCES cls_concept_system (concept_system_id) ,
  included_assertion INTEGER
                    REFERENCES cls_assertion (assertion_id) ,
  PRIMARY KEY (assertor, included_assertion)
);

CREATE TABLE ass_assertion_term
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  term              INTEGER PRIMARY KEY
                    REFERENCES cls_concept (concept_id) ,
  assertion          INTEGER
                    REFERENCES cls_assertion (assertion_id)
);

CREATE TABLE ass_attachment
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  attached_item     INTEGER PRIMARY KEY
                    REFERENCES typ_attached_item (attached_item_id) ,
  owner             INTEGER
                    REFERENCES typ_administered_item (administered_item_id)
);

CREATE TABLE ass_classification_scheme
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  classification    INTEGER
                    REFERENCES asscls_classification (classification_id) ,
  scheme            INTEGER
                    REFERENCES cls_concept_system (concept_system_id) ,
  PRIMARY KEY (classification, scheme)
);

CREATE TABLE ass_concept_source
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  sourced_concept   INTEGER PRIMARY KEY
                    REFERENCES cls_concept (concept_id) ,
  source            INTEGER
                    REFERENCES cls_concept_system (concept_system_id)
);

```

```

CREATE TABLE ass_concept_system_importation
/* a many-to-many reflexive association */
(
  /* columns and foreign keys for roles of the association */
  imported_concept_system          INTEGER
                                REFERENCES cls_concept_system (concept_system_id) ,
  importing_concept_system         INTEGER
                                REFERENCES cls_concept_system (concept_system_id) ,
  PRIMARY KEY (imported_concept_system, importing_concept_system)
);

CREATE TABLE ass_concept_system_membership
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  including_concept_system         INTEGER
                                REFERENCES cls_concept_system (concept_system_id) ,
  member_concept                  INTEGER
                                REFERENCES cls_concept (concept_id) ,
  PRIMARY KEY (including_concept_system, member_concept)
);

CREATE TABLE ass_concept_system_reference
/* a many-to-many reflexive association */
(
  /* columns and foreign keys for roles of the association */
  referenced_concept_system        INTEGER
                                REFERENCES cls_concept_system (concept_system_id) ,
  referencing_concept_system       INTEGER
                                REFERENCES cls_concept_system (concept_system_id) ,
  PRIMARY KEY (referenced_concept_system, referencing_concept_system)
);

CREATE TABLE ass_data_element_concept_domain
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  usage                           INTEGER
                                REFERENCES cls_data_element_concept (data_element_concept_id) ,
  domain                          INTEGER
                                REFERENCES cls_conceptual_domain (conceptual_domain_id) ,
  PRIMARY KEY (usage, domain)
);

CREATE TABLE ass_data_element_concept_object_class
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  object_class                    INTEGER          PRIMARY KEY
                                REFERENCES cls_object_class (object_class_id) ,
  data_element_concept            INTEGER
                                REFERENCES cls_data_element_concept (data_element_concept_id)
);

CREATE TABLE ass_data_element_concept_property
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  property                        INTEGER          PRIMARY KEY
                                REFERENCES cls_property (property_id) ,
  data_element_concept            INTEGER
                                REFERENCES cls_data_element_concept (data_element_concept_id)
);

```

```

CREATE TABLE ass_data_element_meaning
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  representation          INTEGER          PRIMARY KEY
                           REFERENCES cls_data_element (data_element_id) ,
  meaning                 INTEGER
                           REFERENCES cls_data_element_concept (data_element_concept_id)
);

CREATE TABLE ass_derivation_input
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  input                   INTEGER
                           REFERENCES cls_data_element (data_element_id) ,
  inputter                INTEGER
                           REFERENCES cls_data_element_derivation (data_element_derivation_id) ,
  PRIMARY KEY (input, inputter)
);

CREATE TABLE ass_derivation_output
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  output                  INTEGER
                           REFERENCES cls_data_element (data_element_id) ,
  derivation              INTEGER
                           REFERENCES cls_data_element_derivation (data_element_derivation_id) ,
  PRIMARY KEY (output, derivation)
);

CREATE TABLE ass_derivation_rule_application
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  application             INTEGER          PRIMARY KEY
                           REFERENCES cls_data_element (data_element_id) ,
  rule                   INTEGER
                           REFERENCES cls_derivation_rule (derivation_rule_id)
);

CREATE TABLE ass_designation_definition_pairing
/* a one-to-one association */
(
  /* columns and foreign keys for roles of the association */
  definition_heading      INTEGER          UNIQUE
                           REFERENCES cls_designation (designation_id) ,
  specific_definition     INTEGER          UNIQUE
                           REFERENCES cls_definition (definition_id) ,
  PRIMARY KEY (definition_heading, specific_definition)
);

CREATE TABLE ass_designation_namespace
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  included_designation    INTEGER
                           REFERENCES cls_designation (designation_id) ,
  namespace              INTEGER
                           REFERENCES cls_namespace (namespace_id) ,
  PRIMARY KEY (included_designation, namespace)
);

```

```

CREATE TABLE ass_dimensionality_measure_class
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  applicable_unit          INTEGER
                           REFERENCES cls_measure_class (measure_class_id) ,
  dimensionality           INTEGER
                           REFERENCES cls_dimensionality (dimensionality_id) ,
  PRIMARY KEY (applicable_unit, dimensionality)
);

CREATE TABLE ass_exemplification
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  exhibitor                INTEGER
                           REFERENCES cls_data_element (data_element_id) ,
  example                  INTEGER
                           REFERENCES cls_data_element_example (data_element_example_id) ,
  PRIMARY KEY (exhibitor, example)
);

CREATE TABLE ass_identification
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  identified_item           INTEGER          PRIMARY KEY
                           REFERENCES typ_identified_item (identified_item_id) ,
  identifier                INTEGER
                           REFERENCES cls_scoped_identifier
                           (scoped_identifier_id)
);

CREATE TABLE ass_identifier_scope
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  contained_identifier      INTEGER          PRIMARY KEY
                           REFERENCES cls_scoped_identifier
                           (scoped_identifier_id) ,
  scope                    INTEGER
                           REFERENCES cls_namespace (namespace_id)
);

CREATE TABLE ass_item_definition
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  definition                INTEGER          PRIMARY KEY
                           REFERENCES cls_definition (definition_id) ,
  item                     INTEGER
                           REFERENCES typ_designatable_item
                           (designatable_item_id)
);

CREATE TABLE ass_item_designation
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  designation               INTEGER          PRIMARY KEY
                           REFERENCES cls_designation (designation_id) ,
  item                     INTEGER
                           REFERENCES typ_designatable_item
                           (designatable_item_id)
);

```

```

CREATE TABLE ass_item_slot
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  slot                INTEGER                PRIMARY KEY
                      REFERENCES cls_slot (slot_id) ,
  item                INTEGER
                      REFERENCES typ_identified_item (identified_item_id)
);

CREATE TABLE ass_link_end_concept
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  link_end            INTEGER                PRIMARY KEY
                      REFERENCES cls_link_end (link_end_id) ,
  concept             INTEGER
                      REFERENCES cls_concept (concept_id)
);

CREATE TABLE ass_link_end_role
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  link_end            INTEGER                PRIMARY KEY
                      REFERENCES cls_link_end (link_end_id) ,
  role                INTEGER
                      REFERENCES cls_relation_role (relation_role_id)
);

CREATE TABLE ass_link_has_link_end
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  link_end            INTEGER                PRIMARY KEY
                      REFERENCES cls_link_end (link_end_id) ,
  link                INTEGER
                      REFERENCES cls_link (link_id)
);

CREATE TABLE ass_naming_convention_conformance
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  convention          INTEGER
                      REFERENCES cls_naming_convention (naming_convention_id) ,
  conformant_designation INTEGER
                      REFERENCES cls_designation (designation_id) ,
  PRIMARY KEY (convention, conformant_designation)
);

CREATE TABLE ass_naming_convention_utilization
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  acceptable_convention INTEGER
                      REFERENCES cls_naming_convention (naming_convention_id) ,
  utilization          INTEGER
                      REFERENCES cls_namespace (namespace_id) ,
  PRIMARY KEY (acceptable_convention, utilization)
);

```

```

CREATE TABLE ass_permmissible_value_meaning
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  representation          INTEGER          PRIMARY KEY
                           REFERENCES cls_permmissible_value (permmissible_value_id) ,
  meaning                 INTEGER
                           REFERENCES cls_value_meaning (value_meaning_id)
);

CREATE TABLE ass_permmissible_value_set
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  permmissible_value       INTEGER
                           REFERENCES cls_permmissible_value (permmissible_value_id) ,
  containing_domain        INTEGER
                           REFERENCES cls_enumerated_value_domain (value_domain_id) ,
  PRIMARY KEY (permmissible_value, containing_domain)
);

CREATE TABLE ass_registration_authority_namespace
/* a one-to-one association */
(
  /* columns and foreign keys for roles of the association */
  registration_namespace   INTEGER          UNIQUE
                           REFERENCES cls_namespace (namespace_id) ,
  maintainer              INTEGER          UNIQUE
                           REFERENCES cls_registration_authority (registration_authority_id) ,
  PRIMARY KEY (registration_namespace, maintainer)
);

CREATE TABLE ass_registration_authority_namespace
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  usage                   INTEGER          PRIMARY KEY
                           REFERENCES cls_data_element (data_element_id) ,
  domain                  INTEGER
                           REFERENCES cls_value_domain (value_domain_id)
);

CREATE TABLE ass_registration_authority_namespace
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  representation          INTEGER          PRIMARY KEY
                           REFERENCES cls_described_value_domain (value_domain_id) ,
  meaning                 INTEGER
                           REFERENCES cls_described_conceptual_domain (conceptual_domain_id)
);

CREATE TABLE ass_registration_authority_namespace
/* a many-to-many reflexive association */
(
  /* columns and foreign keys for roles of the association */
  superdomain             INTEGER
                           REFERENCES cls_value_domain (value_domain_id) ,
  subdomain               INTEGER
                           REFERENCES cls_value_domain (value_domain_id) ,
  PRIMARY KEY (superdomain, subdomain)
);

```

```

CREATE TABLE ass_registration_authority_registrar
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  registrar                                INTEGER                                PRIMARY KEY
                                     REFERENCES cls_registrar (registrar_id) ,
  authority                                INTEGER
                                     REFERENCES cls_registration_authority (registration_authority_id)
);

CREATE TABLE ass_relation_link
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  link                                    INTEGER                                    PRIMARY KEY
                                     REFERENCES cls_link (link_id) ,
  relation                                INTEGER
                                     REFERENCES cls_relation (relation_id)
);

CREATE TABLE ass_relation_role_set
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  role                                    INTEGER                                    PRIMARY KEY
                                     REFERENCES cls_relation_role (relation_role_id) ,
  source                                INTEGER
                                     REFERENCES cls_relation (relation_id)
);

CREATE TABLE ass_stewardship
/* a one-to-many association */
(
  /* columns and foreign keys for roles of the association */
  stewarded_item                        INTEGER                        PRIMARY KEY
                                     REFERENCES typ_administered_item (administered_item_id) ,
  stewardship_record                    INTEGER
                                     REFERENCES cls_stewardship_record (stewardship_record_id)
);

CREATE TABLE ass_submission
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  submission_record                    INTEGER
                                     REFERENCES cls_submitted_record (submitted_record_id) ,
  submitted_item                        INTEGER
                                     REFERENCES typ_registered_item (registered_item_id) ,
  PRIMARY KEY (submission_record, submitted_item)
);

CREATE TABLE ass_unit_of_measure_class
/* a many-to-many association */
(
  /* columns and foreign keys for roles of the association */
  member_unit                          INTEGER
                                     REFERENCES cls_unit_of_measure (unit_of_measure_id) ,
  measure_class                        INTEGER
                                     REFERENCES cls_measure_class (measure_class_id) ,
  PRIMARY KEY (member_unit, measure_class)
);

```