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Industrial automation systems and integration — Product data representation and exchange —

Part 41: Integrated generic resource: Fundamentals of product description and support

Systèmes d'automatisation industrielle et intégration — Représentation et échange de données de produits —

Partie 41: Ressources génériques intégrées: Principes de description et de support de produits

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Foreword

Foreword.

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Industrial automation systems and integration — Product data representation and exchange —

Part 41:
Integrated generic resource: Fundamentals of product description and support

1 Scope

Scope.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

3.1
Test term
Test definition

4 Two identical schemas to follow, with different anchors

5 action_schema

5.1 General

The subject of the **action_schema** is the description of actions, the reasons for these actions, and the status of these actions.

EXAMPLE Reasons for action include evolving user requirements, manufacturing problems and difficulties that arise when a product is in use.

EXPRESS specification:

```
SCHEMA action_schema '{iso standard 10303 part(41) version(8) object(1) action_
schema(1)}';

REFERENCE FROM basic_attribute_schema
  (description_attribute,
   description_attribute_select,
   get_description_value,
   get_id_value,
   get_name_value,
```

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```
   get_role,
   id_attribute,
   id_attribute_select,
   name_attribute,
   name_attribute_select,
   object_role,
   role_select,
   role_association);

REFERENCE FROM support_resource_schema
  (bag_to_set,
   identifier,
   label,
   text);
```

5.2 Fundamental concepts and assumptions

Action information can be attached to any aspect of product data.

5.3 action_schema type definitions

5.3.1 as_description_attribute_select

EXPRESS specification:

```
TYPE as_description_attribute_select = SELECT BASED_ON description_attribute_select WITH
  (action_request_solution);
END_TYPE;
```

5.3.2 as_id_attribute_select

EXPRESS specification:

```
TYPE as_id_attribute_select = SELECT BASED_ON id_attribute_select WITH
  (action);
END_TYPE;
```

5.3.3 as_name_attribute_select

EXPRESS specification:

```
TYPE as_name_attribute_select = SELECT BASED_ON name_attribute_select WITH
  (action_request_solution);
END_TYPE;
```

5.3.4 as_role_select

EXPRESS specification:

```
TYPE as_role_select = SELECT BASED_ON role_select WITH
  (directed_action_assignment);
END_TYPE;
```

5.3.5 supported_item

The **supported_item** allows for the designation of an action_directive, an action, or an action_method.

NOTE This specifies the use of an action_resource.

EXPRESS specification:

```
TYPE supported_item = SELECT
  (action_directive,
   action,
```

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```
   action_method);
END_TYPE;
```

5.4 action_schema entity definitions

5.4.1 action

An **action** is the identification of the occurrence of an activity and a description of its result.

An **action** identifies an activity that has taken place, is taking place, or is expected to take place in the future.

An action has a definition that is specified by an action_method.

NOTE 1 In particular application domains, terms such as task, process, activity, operation, and event may be synonyms for **action**.

EXAMPLE Change, distilling, design, a process to drill a hole, and a task such as training someone are examples of actions.

EXPRESS specification:

```
ENTITY action;
  name : label;
  description : OPTIONAL text;
  chosen_method : action_method;
DERIVE
  id : identifier := get_id_value(SELF);
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'ID_ATTRIBUTE.IDENTIFIED_ITEM'))
<= 1;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action** is known.

description the text that characterizes the **action**. The value of the attribute need not be specified.

chosen_method the action_method that specifies the procedure selected to carry out the **action** and a description of the results of that **action**.

id the identifier that distinguishes the **action**.

NOTE 2 This attribute is an enhancement to the definition of **action** using a method that is upwardly compatible with ISO 10303-41:1994.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

NOTE 4 The context in which id is used as a discriminating characteristic can be identified in an annotated Express schema that uses or specializes this entity, or by default, in an agreement of common understanding between partners sharing this information.

Attribute definitions:

WR1 Each **action** shall be the identified_item in at most one id_attribute.

NOTE 5 The id_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

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NOTE 6 A template for constraining the population of the entity data types defined in the basic_attribute_schema is described in annex E.

5.4.2 action_directive

An **action_directive** is an authoritative instrument that provides directions to achieve the specified results.

EXAMPLE ISO Directives Part 3 provides guidance for the development of standards documents within ISO.

EXPRESS specification:

```
ENTITY action_directive;
  name : label;
  description : OPTIONAL text;
  analysis : text;
  comment : text;
  requests : SET [1:?] OF versioned_action_request;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_directive** is known.

description the text that characterizes the **action_directive**. The value of the attribute need not be specified.

analysis an informal description of the results of the analysis that was carried out on the elements of the requests set. The request sets are the versioned_action_requests referenced in the requests attribute.

NOTE The reason that different requests are satisfied by the **action_directive** could be recorded in this attribute.

comment an informal description of any other pertinent information.

requests a set of versioned_action_request entity data types that defines the expected results.

5.4.3 action_method

An **action_method** is the definition of an activity. This definition includes the activity's objectives and effects.

NOTE This definition may be the basis for actions or the solution for action requests.

EXAMPLE For the action whose name attribute is 'serve dinner', the name attribute of related instance of **action_method** could be 'cook by recipe' or 'purchase takeout food'.

EXPRESS specification:

```
ENTITY action_method;
  name : label;
  description : OPTIONAL text;
  consequence : text;
  purpose : text;
END_ENTITY;
```

Attribute definitions:

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name the label by which the **action_method** is known.

description the text that characterizes the **action_method**. The value of the attribute need not be specified.

consequence an informal description of the effects of the **action_method**.

purpose an informal description of the objectives of the **action_method**.

5.4.4 action_method_relationship

An **action_method_relationship** is a relationship between two instances of the entity data type action_method and provides an identification and description of this relationship.

NOTE 1 The role of **action_method_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 This entity, together with the action_method entity, is based on the relationship template that is described in annex E.3.

NOTE 3 This entity may be used to define a procedural relationship among constituent activities.

EXPRESS specification:

```
ENTITY action_method_relationship;
  name : label;
  description : OPTIONAL text;
  relating_method : action_method;
  related_method : action_method;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_method_relationship** is known.

description the text that characterizes the **action_method_relationship**. The value of the attribute need not be specified.

relating_method one of the instances of action_method that is a part of the relationship.

NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_method the other instance of action_method that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

NOTE 5 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

5.4.5 action_relationship

An **action_relationship** is a relationship between two instances of the entity data type action and provides an identification and description of this relationship.

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NOTE 1 The role of **action_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

EXPRESS specification:

```
ENTITY action_relationship;
  name : label;
  description : OPTIONAL text;
  relating_action : action;
  related_action : action;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_relationship** is known.

description the text that characterizes the **action_relationship**. The value of the attribute need not be specified.

relating_action one of the instances of action that is a part of the relationship.

NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_action the other instance of action that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

5.4.6 action_request_solution

An **action_request_solution** is an association between a versioned_action_request and an action_method that is a potential solution for the request.

EXPRESS specification:

```
ENTITY action_request_solution;
  method : action_method;
  request : versioned_action_request;
DERIVE
  description : text := get_description_value(SELF);
  name : label := get_name_value(SELF);
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'DESCRIPTION_ATTRIBUTE.DESCRIBED_
ITEM')) <= 1;
  WR2: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'NAME_ATTRIBUTE.NAMED_ITEM')) <= 1;
END_ENTITY;
```

Attribute definitions:

method the action_method that is a potential solution.

request the versioned_action_request for which a solution is specified.

description the text that characterizes the **action_request_solution**.

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NOTE 1 This attribute is an upwardly compatible addition to **action_request_solution** as specified in ISO 10303-41:1994.

name the label by which the **action_request_solution** is known.

NOTE 2 This attribute is an upwardly compatible addition to **action_request_solution** as specified in ISO 10303-41:1994.

Attribute definitions:

WR1 Each **action_request_solution** shall be the described_item in at most one description_attribute.

NOTE 3 The description_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

WR2 Each **action_request_solution** shall be the named_item in at most one name_attribute.

NOTE 4 The name_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

NOTE 5 A template for constraining the population of the entity data types defined in the basic_attribute_schema is described in annex E.

5.4.7 action_request_status

An **action_request_status** is the association of a status with a versioned_action_request.

EXPRESS specification:

```
ENTITY action_request_status;
  status : label;
  assigned_request : versioned_action_request;
END_ENTITY;
```

Attribute definitions:

status the label that provides a user interpretable designation for the level of completion of the action.

NOTE The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

assigned_request the versioned_action_request to which the **status** applies.

5.4.8 action_resource

An **action_resource** is a thing that is identified as being needed to carry out an action.

EXPRESS specification:

```
ENTITY action_resource;
  name : label;
  description : OPTIONAL text;
  usage : SET [1:?] OF supported_item;
  kind : action_resource_type;
END_ENTITY;
```

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Attribute definitions:

name the label by which the **action_resource** is known.

description the text that characterizes the **action_resource**. The value of the attribute need not be specified.

usage a set of supported_items for which the **action_resource** is used.

kind the action_resource_type that specifies the sort of **action_resource** that is being used.

5.4.9 action_resource_relationship

An **action_resource_relationship** is a relationship between two instances of the entity data type action_resource and provides an identification and description of this relationship.

NOTE 1 The role of **action_resource_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 This entity, together with the action_resource entity, is based on the relationship template that is described in annex E.3.

EXPRESS specification:

```
ENTITY action_resource_relationship;
  name : label;
  description : OPTIONAL text;
  relating_resource : action_resource;
  related_resource : action_resource;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_resource_relationship** is known.

description the text that characterizes the **action_resource_relationship**. The value of the attribute need not be specified.

relating_resource one of the instances of action_resource that is a part of the relationship.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_resource the other instance of action_resource that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

5.4.10 action_resource_type

An **action_resource_type** is the identification of the kind of action_resource needed to carry out an action.

EXAMPLE This entity may be used to specify the kind of tool needed to perform a process operation.

EXPRESS specification:

```
ENTITY action_resource_type;
```


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```
  name : label;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_resource_type** is known.

5.4.11 action_status

An **action_status** is the association of a status with an executed_action.

NOTE 1 Information about the date and time may be associated with the **action_status** through the use of date_assignment, date_and_time_assignment, or time_assignment.

EXPRESS specification:

```
ENTITY action_status;
  status : label;
  assigned_action : executed_action;
END_ENTITY;
```

Attribute definitions:

status the label that provides a user interpretable designation for the level of completion of the action.

NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

EXAMPLE Terms such as 'pending', 'completed', or 'scheduled' are examples of status.

assigned_action the executed_action to which the status applies.

5.4.12 directed_action

A **directed_action** is a type of executed_action that is governed by an action_directive.

EXAMPLE A **directed_action** could be the inspection of a building as directed by city officials according to the city building codes for earthquake safety. The action is the inspection of the building. The directive is issued by city officials guided by the city building codes. In an application protocol, the building authority may be associated with an organization_assignment. The building codes may be associated with a document_reference.

EXPRESS specification:

```
ENTITY directed_action
  SUBTYPE OF (executed_action);
  directive : action_directive;
END_ENTITY;
```

Attribute definitions:

directive the action_directive that governs the **directed_action**.

5.4.13 directed_action_assignment

A **directed_action_assignment** is an association of a directed_action with product data.

EXPRESS specification:

```
ENTITY directed_action_assignment
```

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```
  ABSTRACT SUPERTYPE;
  assigned_directed_action : directed_action;
DERIVE
  role : object_role := get_role(SELF);
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'ROLE_ASSOCIATION.ITEM_WITH_
ROLE')) <= 1;
END_ENTITY;
```

Attribute definitions:

assigned_directed_action the instance of the **directed_action** entity data that is to be associated with product data.

role the **object_role** that specifies the purpose of the association of the **directed_action_assignment** with product data.

Attribute definitions:

WR1 Each **directed_action_assignment** shall be **item_with_role** in at most one role_association.

5.4.14 executed_action

An **executed_action** is a type of action that is completed, partially completed, or just identified. It may but need not have status information associated with it.

NOTE 1 The role of **executed_action** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 Status information is associated to **executed_action** through action_status.

EXAMPLE An **executed_action** could be to 'paint the office' with a status of 'scheduled'. The action is 'paint the office'. The status further qualifies the action as 'planned', 'scheduled', or 'completed'.

EXPRESS specification:

```
ENTITY executed_action
  SUBTYPE OF (action);
END_ENTITY;
```

5.4.15 versioned_action_request

A **versioned_action_request** is a specification of a desired result.

NOTE 1 The desired result being identified and described may be obtained through one of more action_methods.

EXPRESS specification:

```
ENTITY versioned_action_request;
  id : identifier;
  version : OPTIONAL label;
  purpose : text;
  description : OPTIONAL text;
END_ENTITY;
```

Attribute definitions:

id the identifier that distinguishes the **versioned_action_request**.

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NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

NOTE 3 The context in which id is used as a discriminating characteristic can be identified in an annotated Express schema that uses or specializes this entity, or by default, in an agreement of common understanding between partners sharing this information.

version the identification of the version of the **versioned_action_request**. The value of the attribute need not be specified.

purpose an informal description of the reason for the **versioned_action_request**.

description the text that characterizes the **versioned_action_request**. The value of the attribute need not be specified.

5.4.16 versioned_action_request_relationship

A **versioned_action_request_relationship** is a relationship between two versioned_action_request objects.

NOTE 1 Two versioned_action_request objects may be related if they address similar problems.

NOTE 2 A versioned_action_request may be a version of a work request. It might be related to a different version of the work request using a **versioned_action_request_relationship**.

EXPRESS specification:

```
ENTITY versioned_action_request_relationship;
  id : identifier;
  name : label;
  description : OPTIONAL text;
  relating_versioned_action_request : versioned_action_request;
  related_versioned_action_request : versioned_action_request;
END_ENTITY;
```

Attribute definitions:

id the identifier that distinguishes the **versioned_action_request_relationship**.

name the label by which the **versioned_action_request_relationship** is known.

description the text that characterizes the **versioned_action_request_relationship**. The value of this attribute need not be specified.

relating_versioned_action_request one of the instances of versioned_action_request that is a part of the relationship.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_versioned_action_request the other instance of versioned_action_request that is a part of the relationship. If one element of the relationship is dependent upon the other, this attribute shall be the dependent one.

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NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

5.4.17 action_directive_relationship

An **action_directive_relationship** is a relationship between two action_directive objects.

EXPRESS specification:

```
ENTITY action_directive_relationship;
  name : label;
  description : OPTIONAL STRING;
  relating : action_directive;
  related : action_directive;
  relation_type : STRING;
WHERE
  WR1: acyclic_action_directive_relationship(SELF, [related], 'ACTION_SCHEMA.ACTION_
DIRECTIVE_RELATIONSHIP');
END_ENTITY;
```

Attribute definitions:

name shall be unique within a population of **action_directive_relationship**.

description the text or the set of texts that provide further information about the **action_directive_relationship**. The value of this attribute need not be specified.

relating one object of action_directive that is part of the relationship.

related the other object of action_directive that is part of the relationship.

relation_type the meaning of the relationship.

Attribute definitions:

WR1 A **action_directive_relationship** shall not participate in its own definition.

5.5 action_schema function definitions

5.5.1 acyclic_action_method_relationship

The **acyclic_action_method_relationship** function determines whether the graph of instances of the entity data type action_method that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_method_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_method_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_action_method_relationship(relation : action_method_relationship;
                                            relatives : SET [1:?] OF action_method;
                                            specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_method_relationship;
  END_LOCAL;
  IF relation.relating_method IN relatives THEN
```

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```
    RETURN (FALSE);
  END_IF;
  x := QUERY(am <* bag_to_set(USEDIN(relation.relating_method, ('ACTION_SCHEMA.' +
'ACTION_METHOD_RELATIONSHIP.') + 'RELATED')) | specific_relation IN TYPEOF(am));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_method_relationship(x[i], relatives + relation.relating_method,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

5.5.1.1 Parameters

5.5.1.1.1 relation

(input) the candidate action_method_relationship to be checked.

EXPRESS specification:

```
relation : action_method_relationship
```

5.5.1.1.2 relatives

(input) the set of instances of the entity data type action_method that the function is searching for in the relating_method parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action_method
```

5.5.1.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_method_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

5.5.1.2 Variables

5.5.1.2.1 x

EXPRESS specification:

```
x : SET OF action_method_relationship;
```

5.5.1.3 Statements

5.5.1.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_method_relationship(x[i], relatives + relation.relating_method,
specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

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5.5.2 acyclic_action_relationship

The **acyclic_action_relationship** function determines whether the graph of instances of the entity data type action that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_action_relationship(relation : action_relationship;
                                     relatives : SET [1:?] OF action;
                                     specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_relationship;
  END_LOCAL;
  IF relation.relating_action IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(actn <* bag_to_set(USEDIN(relation.relating_action, ('ACTION_SCHEMA.' +
'ACTION_RELATIONSHIP.') + 'RELATED_ACTION')) | specific_relation IN TYPEOF(actn));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_relationship(x[i], relatives + relation.relating_action,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

5.5.2.1 Parameters

5.5.2.1.1 relation

(input) the candidate action_relationship to be checked.

EXPRESS specification:

```
relation : action_relationship
```

5.5.2.1.2 relatives

(input) the set of instances of the entity data type action for which the function is searching in the relating_action parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action
```

5.5.2.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

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5.5.2.2 Variables

5.5.2.2.1 x

EXPRESS specification:

```
x : SET OF action_relationship;
```

5.5.2.3 Statements

5.5.2.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_relationship(x[i], relatives + relation.relating_action, specific_
relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

5.5.3 acyclic_action_resource_relationship

The **acyclic_action_resource_relationship** function determines whether the graph of instances of the entity data type action_resource that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_resource_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_resource_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_action_resource_relationship(relation : action_resource_relationship;
                                              relatives : SET [1:?] OF action_resource;
                                              specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_resource_relationship;
  END_LOCAL;
  IF relation.relating_resource IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(ar <* bag_to_set(USEDIN(relation.relating_resource, ('ACTION_SCHEMA.
' + 'ACTION_RESOURCE_RELATIONSHIP.') + 'RELATED_RESOURCE')) | specific_relation IN
TYPEOF(ar));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_resource_relationship(x[i], relatives + relation.relating_
resource, specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

5.5.3.1 Parameters

5.5.3.1.1 relation

(input) the candidate action_resource_relationship to be checked.

EXPRESS specification:

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```
relation : action_resource_relationship
```

5.5.3.1.2 relatives

(input) the set of instances of the entity data type action_resource that the function is searching for in the relating_resource parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action_resource
```

5.5.3.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_resource_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

5.5.3.2 Variables

5.5.3.2.1 x

EXPRESS specification:

```
x : SET OF action_resource_relationship;
```

5.5.3.3 Statements

5.5.3.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_resource_relationship(x[i], relatives + relation.relating_
resource, specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

5.5.4 acyclic_versioned_action_request_relationship

The **acyclic_versioned_action_request_relationship** function determines whether the graph of instances of the entity data type versioned_action_request that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_resource_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the versioned_action_request_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_versioned_action_request_relationship(relation : versioned_action_
request_relationship;
                                                       relatives : SET OF versioned_
action_request;
                                                       specific_relation : STRING) :
BOOLEAN;
  LOCAL
    x : SET OF versioned_action_request_relationship;
  END_LOCAL;
```

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```
  IF relation.relating_versioned_action_request IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(varr <* bag_to_set(USEDIN(relation.relating_versioned_action_request,
('ACTION_SCHEMA.' + 'VERSIONED_ACTION_REQUEST_RELATIONSHIP.') + 'RELATED_VERSIONED_ACTION_
REQUEST')) | specific_relation IN TYPEOF(varr));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_versioned_action_request_relationship(x[i], relatives + relation.
relating_versioned_action_request, specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

5.5.4.1 Parameters

5.5.4.1.1 relation

(input) the candidate versioned_action_request_relationship to be checked.

EXPRESS specification:

```
relation : versioned_action_request_relationship
```

5.5.4.1.2 relatives

(input) the set of instances of the entity data type versioned_action_request that the function is searching for in the relating_versioned_action_request parameter of the relation argument.

EXPRESS specification:

```
relatives : SET OF versioned_action_request
```

5.5.4.1.3 specific_relation

(input) the fully qualified name of a subtype of the versioned_action_request_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

5.5.4.2 Variables

5.5.4.2.1 x

EXPRESS specification:

```
x : SET OF versioned_action_request_relationship;
```

5.5.4.3 Statements

5.5.4.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_versioned_action_request_relationship(x[i], relatives + relation.
relating_versioned_action_request, specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

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5.5.5 acyclic_action_directive_relationship

The **acyclic_action_directive_relationship** function determines whether the graph of instance of the entity data type action_directive that contains relation as one of its links contains a cycle. this function may be used to evaluate either a action_directive_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE The algorithm of the function is explained in annex E.2.

EXPRESS specification:

```
FUNCTION acyclic_action_directive_relationship(relation : action_directive_relationship;
                                               relatives : SET [1:?] OF action_directive;
                                               specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_directive_relationship;
  END_LOCAL;
  IF relation.relating IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(adr <* bag_to_set(USEDIN(relation.relating, ('ACTION_SCHEMA.' + 'ACTION_
DIRECTIVE_RELATIONSHIP.') + 'RELATED')) | specific_relation IN TYPEOF(adr));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_directive_relationship(x[i], relatives + relation.relating,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

5.5.5.1 Parameters

5.5.5.1.1 relation

(input) the candidate action_directive_relationship to be checked.

EXPRESS specification:

```
relation : action_directive_relationship
```

5.5.5.1.2 relatives

(input) the set of instances of the entity data type action_directive for which the function is searching in the relating parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action_directive
```

5.5.5.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_directive_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

5.5.5.2 Variables

5.5.5.2.1 x

EXPRESS specification:

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```
x : SET OF action_directive_relationship;
```

5.5.5.3 Statements

5.5.5.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_directive_relationship(x[i], relatives + relation.relating,
specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

6 action_schema

6.1 General

The subject of the **action_schema** is the description of actions, the reasons for these actions, and the status of these actions.

EXAMPLE Reasons for action include evolving user requirements, manufacturing problems and difficulties that arise when a product is in use.

EXPRESS specification:

```
SCHEMA action_schema '{iso standard 10303 part(41) version(8) object(1) action_
schema(1)}';

REFERENCE FROM basic_attribute_schema
  (description_attribute,
   description_attribute_select,
   get_description_value,
   get_id_value,
   get_name_value,
   get_role,
   id_attribute,
   id_attribute_select,
   name_attribute,
   name_attribute_select,
   object_role,
   role_select,
   role_association);

REFERENCE FROM support_resource_schema
  (bag_to_set,
   identifier,
   label,
   text);
```

6.2 Fundamental concepts and assumptions

Action information can be attached to any aspect of product data.

6.3 action_schema type definitions

6.3.1 as_description_attribute_select

EXPRESS specification:

```
TYPE as_description_attribute_select = SELECT BASED_ON description_attribute_select WITH
  (action_request_solution);
```

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```
END_TYPE;
```

6.3.2 as_id_attribute_select

EXPRESS specification:

```
TYPE as_id_attribute_select = SELECT BASED_ON id_attribute_select WITH
  (action);
END_TYPE;
```

6.3.3 as_name_attribute_select

EXPRESS specification:

```
TYPE as_name_attribute_select = SELECT BASED_ON name_attribute_select WITH
  (action_request_solution);
END_TYPE;
```

6.3.4 as_role_select

EXPRESS specification:

```
TYPE as_role_select = SELECT BASED_ON role_select WITH
  (directed_action_assignment);
END_TYPE;
```

6.3.5 supported_item

The **supported_item** allows for the designation of an action_directive, an action, or an action_method.

NOTE This specifies the use of an action_resource.

EXPRESS specification:

```
TYPE supported_item = SELECT
  (action_directive,
   action,
   action_method);
END_TYPE;
```

6.4 action_schema entity definitions

6.4.1 action

An **action** is the identification of the occurrence of an activity and a description of its result.

An **action** identifies an activity that has taken place, is taking place, or is expected to take place in the future.

An action has a definition that is specified by an action_method.

NOTE 1 In particular application domains, terms such as task, process, activity, operation, and event may be synonyms for **action**.

EXAMPLE Change, distilling, design, a process to drill a hole, and a task such as training someone are examples of actions.

EXPRESS specification:

```
ENTITY action;
  name : label;
  description : OPTIONAL text;
  chosen_method : action_method;
DERIVE
  id : identifier := get_id_value(SELF);
```

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```
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'ID_ATTRIBUTE.IDENTIFIED_ITEM'))
<= 1;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action** is known.

description the text that characterizes the **action**. The value of the attribute need not be specified.

chosen_method the action_method that specifies the procedure selected to carry out the **action** and a description of the results of that **action**.

id the identifier that distinguishes the **action**.

NOTE 2 This attribute is an enhancement to the definition of **action** using a method that is upwardly compatible with ISO 10303-41:1994.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

NOTE 4 The context in which id is used as a discriminating characteristic can be identified in an annotated Express schema that uses or specializes this entity, or by default, in an agreement of common understanding between partners sharing this information.

Attribute definitions:

WR1 Each **action** shall be the identified_item in at most one id_attribute.

NOTE 5 The id_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

NOTE 6 A template for constraining the population of the entity data types defined in the basic_attribute_schema is described in annex E.

6.4.2 action_directive

An **action_directive** is an authoritative instrument that provides directions to achieve the specified results.

EXAMPLE ISO Directives Part 3 provides guidance for the development of standards documents within ISO.

EXPRESS specification:

```
ENTITY action_directive;
  name : label;
  description : OPTIONAL text;
  analysis : text;
  comment : text;
  requests : SET [1:?] OF versioned_action_request;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_directive** is known.

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description the text that characterizes the **action_directive**. The value of the attribute need not be specified.

analysis an informal description of the results of the analysis that was carried out on the elements of the requests set. The request sets are the versioned_action_requests referenced in the requests attribute.

NOTE The reason that different requests are satisfied by the **action_directive** could be recorded in this attribute.

comment an informal description of any other pertinent information.

requests a set of versioned_action_request entity data types that defines the expected results.

6.4.3 action_method

An **action_method** is the definition of an activity. This definition includes the activity's objectives and effects.

NOTE This definition may be the basis for actions or the solution for action requests.

EXAMPLE For the action whose name attribute is 'serve dinner', the name attribute of related instance of **action_method** could be 'cook by recipe' or 'purchase takeout food'.

EXPRESS specification:

```
ENTITY action_method;
  name : label;
  description : OPTIONAL text;
  consequence : text;
  purpose : text;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_method** is known.

description the text that characterizes the **action_method**. The value of the attribute need not be specified.

consequence an informal description of the effects of the **action_method**.

purpose an informal description of the objectives of the **action_method**.

6.4.4 action_method_relationship

An **action_method_relationship** is a relationship between two instances of the entity data type action_method and provides an identification and description of this relationship.

NOTE 1 The role of **action_method_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 This entity, together with the action_method entity, is based on the relationship template that is described in annex E.3.

NOTE 3 This entity may be used to define a procedural relationship among constituent activities.

EXPRESS specification:

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```
ENTITY action_method_relationship;
  name : label;
  description : OPTIONAL text;
  relating_method : action_method;
  related_method : action_method;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_method_relationship** is known.

description the text that characterizes the **action_method_relationship**. The value of the attribute need not be specified.

relating_method one of the instances of action_method that is a part of the relationship.

NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_method the other instance of action_method that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

NOTE 5 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

6.4.5 action_relationship

An **action_relationship** is a relationship between two instances of the entity data type action and provides an identification and description of this relationship.

NOTE 1 The role of **action_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

EXPRESS specification:

```
ENTITY action_relationship;
  name : label;
  description : OPTIONAL text;
  relating_action : action;
  related_action : action;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_relationship** is known.

description the text that characterizes the **action_relationship**. The value of the attribute need not be specified.

relating_action one of the instances of action that is a part of the relationship.

NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_action the other instance of action that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

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NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

6.4.6 action_request_solution

An **action_request_solution** is an association between a versioned_action_request and an action_method that is a potential solution for the request.

EXPRESS specification:

```
ENTITY action_request_solution;
  method : action_method;
  request : versioned_action_request;
DERIVE
  description : text := get_description_value(SELF);
  name : label := get_name_value(SELF);
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'DESCRIPTION_ATTRIBUTE.DESCRIBED_
ITEM')) <= 1;
  WR2: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'NAME_ATTRIBUTE.NAMED_ITEM')) <= 1;
END_ENTITY;
```

Attribute definitions:

method the action_method that is a potential solution.

request the versioned_action_request for which a solution is specified.

description the text that characterizes the **action_request_solution**.

NOTE 1 This attribute is an upwardly compatible addition to **action_request_solution** as specified in ISO 10303-41:1994.

name the label by which the **action_request_solution** is known.

NOTE 2 This attribute is an upwardly compatible addition to **action_request_solution** as specified in ISO 10303-41:1994.

Attribute definitions:

WR1 Each **action_request_solution** shall be the described_item in at most one description_attribute.

NOTE 3 The description_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

WR2 Each **action_request_solution** shall be the named_item in at most one name_attribute.

NOTE 4 The name_attribute data type is defined in basic_attribute_schema of this part of ISO 10303.

NOTE 5 A template for constraining the population of the entity data types defined in the basic_attribute_schema is described in annex E.

6.4.7 action_request_status

An **action_request_status** is the association of a status with a versioned_action_request.

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EXPRESS specification:

```
ENTITY action_request_status;
  status : label;
  assigned_request : versioned_action_request;
END_ENTITY;
```

Attribute definitions:

status the label that provides a user interpretable designation for the level of completion of the action.

NOTE The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

assigned_request the versioned_action_request to which the **status** applies.

6.4.8 action_resource

An **action_resource** is a thing that is identified as being needed to carry out an action.

EXPRESS specification:

```
ENTITY action_resource;
  name : label;
  description : OPTIONAL text;
  usage : SET [1:?] OF supported_item;
  kind : action_resource_type;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_resource** is known.

description the text that characterizes the **action_resource**. The value of the attribute need not be specified.

usage a set of supported_items for which the **action_resource** is used.

kind the action_resource_type that specifies the sort of **action_resource** that is being used.

6.4.9 action_resource_relationship

An **action_resource_relationship** is a relationship between two instances of the entity data type action_resource and provides an identification and description of this relationship.

NOTE 1 The role of **action_resource_relationship** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 This entity, together with the action_resource entity, is based on the relationship template that is described in annex E.3.

EXPRESS specification:

```
ENTITY action_resource_relationship;
  name : label;
  description : OPTIONAL text;
  relating_resource : action_resource;
  related_resource : action_resource;
```

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```
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_resource_relationship** is known.

description the text that characterizes the **action_resource_relationship**. The value of the attribute need not be specified.

relating_resource one of the instances of action_resource that is a part of the relationship.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_resource the other instance of action_resource that is a part of the relationship. If one element of the relationship is dependent upon the other this attribute shall be the dependent one.

NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

6.4.10 action_resource_type

An **action_resource_type** is the identification of the kind of action_resource needed to carry out an action.

EXAMPLE This entity may be used to specify the kind of tool needed to perform a process operation.

EXPRESS specification:

```
ENTITY action_resource_type;
  name : label;
END_ENTITY;
```

Attribute definitions:

name the label by which the **action_resource_type** is known.

6.4.11 action_status

An **action_status** is the association of a status with an executed_action.

NOTE 1 Information about the date and time may be associated with the **action_status** through the use of date_assignment, date_and_time_assignment, or time_assignment.

EXPRESS specification:

```
ENTITY action_status;
  status : label;
  assigned_action : executed_action;
END_ENTITY;
```

Attribute definitions:

status the label that provides a user interpretable designation for the level of completion of the action.

NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

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EXAMPLE Terms such as 'pending', 'completed', or 'scheduled' are examples of status.

assigned_action the executed_action to which the status applies.

6.4.12 directed_action

A **directed_action** is a type of executed_action that is governed by an action_directive.

EXAMPLE A **directed_action** could be the inspection of a building as directed by city officials according to the city building codes for earthquake safety. The action is the inspection of the building. The directive is issued by city officials guided by the city building codes. In an application protocol, the building authority may be associated with an organization_assignment. The building codes may be associated with a document_reference.

EXPRESS specification:

```
ENTITY directed_action
  SUBTYPE OF (executed_action);
  directive : action_directive;
END_ENTITY;
```

Attribute definitions:

directive the action_directive that governs the **directed_action**.

6.4.13 directed_action_assignment

A **directed_action_assignment** is an association of a directed_action with product data.

EXPRESS specification:

```
ENTITY directed_action_assignment
  ABSTRACT SUPERTYPE;
  assigned_directed_action : directed_action;
DERIVE
  role : object_role := get_role(SELF);
WHERE
  WR1: SIZEOF(USEDIN(SELF, 'BASIC_ATTRIBUTE_SCHEMA.' + 'ROLE_ASSOCIATION.ITEM_WITH_
ROLE')) <= 1;
END_ENTITY;
```

Attribute definitions:

assigned_directed_action the instance of the **directed_action** entity data that is to be associated with product data.

role the **object_role** that specifies the purpose of the association of the **directed_action_assignment** with product data.

Attribute definitions:

WR1 Each **directed_action_assignment** shall be **item_with_role** in at most one role_association.

6.4.14 executed_action

An **executed_action** is a type of action that is completed, partially completed, or just identified. It may but need not have status information associated with it.

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NOTE 1 The role of **executed_action** can be defined in the annotated EXPRESS schemas that use or specialize this entity, or by default, in an agreement of common understanding between the partners sharing this information.

NOTE 2 Status information is associated to **executed_action** through action_status.

EXAMPLE An **executed_action** could be to 'paint the office' with a status of 'scheduled'. The action is 'paint the office'. The status further qualifies the action as 'planned', 'scheduled', or 'completed'.

EXPRESS specification:

```
ENTITY executed_action
  SUBTYPE OF (action);
END_ENTITY;
```

6.4.15 versioned_action_request

A **versioned_action_request** is a specification of a desired result.

NOTE 1 The desired result being identified and described may be obtained through one of more action_methods.

EXPRESS specification:

```
ENTITY versioned_action_request;
  id : identifier;
  version : OPTIONAL label;
  purpose : text;
  description : OPTIONAL text;
END_ENTITY;
```

Attribute definitions:

id the identifier that distinguishes the **versioned_action_request**.

NOTE 2 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

NOTE 3 The context in which id is used as a discriminating characteristic can be identified in an annotated Express schema that uses or specializes this entity, or by default, in an agreement of common understanding between partners sharing this information.

version the identification of the version of the **versioned_action_request**. The value of the attribute need not be specified.

purpose an informal description of the reason for the **versioned_action_request**.

description the text that characterizes the **versioned_action_request**. The value of the attribute need not be specified.

6.4.16 versioned_action_request_relationship

A **versioned_action_request_relationship** is a relationship between two versioned_action_request objects.

NOTE 1 Two versioned_action_request objects may be related if they address similar problems.

NOTE 2 A versioned_action_request may be a version of a work request. It might be related to a different version of the work request using a **versioned_action_request_relationship**.

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EXPRESS specification:

```
ENTITY versioned_action_request_relationship;
  id : identifier;
  name : label;
  description : OPTIONAL text;
  relating_versioned_action_request : versioned_action_request;
  related_versioned_action_request : versioned_action_request;
END_ENTITY;
```

Attribute definitions:

id the identifier that distinguishes the **versioned_action_request_relationship**.

name the label by which the **versioned_action_request_relationship** is known.

description the text that characterizes the **versioned_action_request_relationship**. The value of this attribute need not be specified.

relating_versioned_action_request one of the instances of versioned_action_request that is a part of the relationship.

NOTE 3 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

related_versioned_action_request the other instance of versioned_action_request that is a part of the relationship. If one element of the relationship is dependent upon the other, this attribute shall be the dependent one.

NOTE 4 The meaning of this attribute can be defined in the annotated EXPRESS schemas that use or specialize this entity, or in an agreement of common understanding between the partners sharing this information.

6.4.17 action_directive_relationship

An **action_directive_relationship** is a relationship between two action_directive objects.

EXPRESS specification:

```
ENTITY action_directive_relationship;
  name : label;
  description : OPTIONAL STRING;
  relating : action_directive;
  related : action_directive;
  relation_type : STRING;
WHERE
  WR1: acyclic_action_directive_relationship(SELF, [related], 'ACTION_SCHEMA.ACTION_
DIRECTIVE_RELATIONSHIP');
END_ENTITY;
```

Attribute definitions:

name shall be unique within a population of **action_directive_relationship**.

description the text or the set of texts that provide further information about the **action_directive_relationship**. The value of this attribute need not be specified.

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relating one object of action_directive that is part of the relationship.

related the other object of action_directive that is part of the relationship.

relation_type the meaning of the relationship.

Attribute definitions:

WR1 A **action_directive_relationship** shall not participate in its own definition.

6.5 action_schema function definitions

6.5.1 acyclic_action_method_relationship

The **acyclic_action_method_relationship** function determines whether the graph of instances of the entity data type action_method that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_method_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_method_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_action_method_relationship(relation : action_method_relationship;
                                            relatives : SET [1:?] OF action_method;
                                            specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_method_relationship;
  END_LOCAL;
  IF relation.relating_method IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(am <* bag_to_set(USEDIN(relation.relating_method, ('ACTION_SCHEMA.' +
'ACTION_METHOD_RELATIONSHIP.') + 'RELATED')) | specific_relation IN TYPEOF(am));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_method_relationship(x[i], relatives + relation.relating_method,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

6.5.1.1 Parameters

6.5.1.1.1 relation

(input) the candidate action_method_relationship to be checked.

EXPRESS specification:

```
relation : action_method_relationship
```

6.5.1.1.2 relatives

(input) the set of instances of the entity data type action_method that the function is searching for in the relating_method parameter of the relation argument.

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EXPRESS specification:

```
relatives : SET [1:?] OF action_method
```

6.5.1.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_method_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

6.5.1.2 Variables

6.5.1.2.1 x

EXPRESS specification:

```
x : SET OF action_method_relationship;
```

6.5.1.3 Statements

6.5.1.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_method_relationship(x[i], relatives + relation.relating_method,
specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

6.5.2 acyclic_action_relationship

The **acyclic_action_relationship** function determines whether the graph of instances of the entity data type action that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_action_relationship(relation : action_relationship;
                                     relatives : SET [1:?] OF action;
                                     specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_relationship;
  END_LOCAL;
  IF relation.relating_action IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(actn <* bag_to_set(USEDIN(relation.relating_action, ('ACTION_SCHEMA.' +
'ACTION_RELATIONSHIP.') + 'RELATED_ACTION')) | specific_relation IN TYPEOF(actn));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_relationship(x[i], relatives + relation.relating_action,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
```

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```
  RETURN (TRUE);
END_FUNCTION;
```

6.5.2.1 Parameters

6.5.2.1.1 relation

(input) the candidate action_relationship to be checked.

EXPRESS specification:

```
relation : action_relationship
```

6.5.2.1.2 relatives

(input) the set of instances of the entity data type action for which the function is searching in the relating_action parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action
```

6.5.2.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

6.5.2.2 Variables

6.5.2.2.1 x

EXPRESS specification:

```
x : SET OF action_relationship;
```

6.5.2.3 Statements

6.5.2.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_relationship(x[i], relatives + relation.relating_action, specific_
relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

6.5.3 acyclic_action_resource_relationship

The **acyclic_action_resource_relationship** function determines whether the graph of instances of the entity data type action_resource that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_resource_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the action_resource_relationship entity include rules that use this function.

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EXPRESS specification:

```
FUNCTION acyclic_action_resource_relationship(relation : action_resource_relationship;
                                              relatives : SET [1:?] OF action_resource;
                                              specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_resource_relationship;
  END_LOCAL;
  IF relation.relating_resource IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(ar <* bag_to_set(USEDIN(relation.relating_resource, ('ACTION_SCHEMA.
' + 'ACTION_RESOURCE_RELATIONSHIP.') + 'RELATED_RESOURCE')) | specific_relation IN
TYPEOF(ar));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_resource_relationship(x[i], relatives + relation.relating_
resource, specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

6.5.3.1 Parameters

6.5.3.1.1 relation

(input) the candidate action_resource_relationship to be checked.

EXPRESS specification:

```
relation : action_resource_relationship
```

6.5.3.1.2 relatives

(input) the set of instances of the entity data type action_resource that the function is searching for in the relating_resource parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action_resource
```

6.5.3.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_resource_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

6.5.3.2 Variables

6.5.3.2.1 x

EXPRESS specification:

```
x : SET OF action_resource_relationship;
```

6.5.3.3 Statements

6.5.3.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
```

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```
  IF NOT acyclic_action_resource_relationship(x[i], relatives + relation.relating_
resource, specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

6.5.4 acyclic_versioned_action_request_relationship

The **acyclic_versioned_action_request_relationship** function determines whether the graph of instances of the entity data type versioned_action_request that contains relation as one of its links contains a cycle. This function may be used to evaluate either an action_resource_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE 1 The algorithm of the function is explained in annex E.2.

NOTE 2 This function is not used in this schema. It is defined here because other ISO 10303 integrated resources and application protocols that use the versioned_action_request_relationship entity include rules that use this function.

EXPRESS specification:

```
FUNCTION acyclic_versioned_action_request_relationship(relation : versioned_action_
request_relationship;
                                                       relatives : SET OF versioned_
action_request;
                                                       specific_relation : STRING) :
BOOLEAN;
  LOCAL
    x : SET OF versioned_action_request_relationship;
  END_LOCAL;
  IF relation.relating_versioned_action_request IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(varr <* bag_to_set(USEDIN(relation.relating_versioned_action_request,
('ACTION_SCHEMA.' + 'VERSIONED_ACTION_REQUEST_RELATIONSHIP.') + 'RELATED_VERSIONED_ACTION_
REQUEST')) | specific_relation IN TYPEOF(varr));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_versioned_action_request_relationship(x[i], relatives + relation.
relating_versioned_action_request, specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

6.5.4.1 Parameters

6.5.4.1.1 relation

(input) the candidate versioned_action_request_relationship to be checked.

EXPRESS specification:

```
relation : versioned_action_request_relationship
```

6.5.4.1.2 relatives

(input) the set of instances of the entity data type versioned_action_request that the function is searching for in the relating_versioned_action_request parameter of the relation argument.

EXPRESS specification:

```
relatives : SET OF versioned_action_request
```

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6.5.4.1.3 specific_relation

(input) the fully qualified name of a subtype of the versioned_action_request_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

6.5.4.2 Variables

6.5.4.2.1 x

EXPRESS specification:

```
x : SET OF versioned_action_request_relationship;
```

6.5.4.3 Statements

6.5.4.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_versioned_action_request_relationship(x[i], relatives + relation.
relating_versioned_action_request, specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```

6.5.5 acyclic_action_directive_relationship

The **acyclic_action_directive_relationship** function determines whether the graph of instance of the entity data type action_directive that contains relation as one of its links contains a cycle. this function may be used to evaluate either a action_directive_relationship or any of its subtypes.

The function returns TRUE if no cycle has been detected. Otherwise it returns FALSE.

NOTE The algorithm of the function is explained in annex E.2.

EXPRESS specification:

```
FUNCTION acyclic_action_directive_relationship(relation : action_directive_relationship;
                                               relatives : SET [1:?] OF action_directive;
                                               specific_relation : STRING) : BOOLEAN;
  LOCAL
    x : SET OF action_directive_relationship;
  END_LOCAL;
  IF relation.relating IN relatives THEN
    RETURN (FALSE);
  END_IF;
  x := QUERY(adr <* bag_to_set(USEDIN(relation.relating, ('ACTION_SCHEMA.' + 'ACTION_
DIRECTIVE_RELATIONSHIP.') + 'RELATED')) | specific_relation IN TYPEOF(adr));
  REPEAT i := 1 TO HIINDEX(x);
    IF NOT acyclic_action_directive_relationship(x[i], relatives + relation.relating,
specific_relation) THEN
      RETURN (FALSE);
    END_IF;
  END_REPEAT;
  RETURN (TRUE);
END_FUNCTION;
```

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6.5.5.1 Parameters

6.5.5.1.1 relation

(input) the candidate action_directive_relationship to be checked.

EXPRESS specification:

```
relation : action_directive_relationship
```

6.5.5.1.2 relatives

(input) the set of instances of the entity data type action_directive for which the function is searching in the relating parameter of the relation argument.

EXPRESS specification:

```
relatives : SET [1:?] OF action_directive
```

6.5.5.1.3 specific_relation

(input) the fully qualified name of a subtype of the action_directive_relationship entity.

EXPRESS specification:

```
specific_relation : STRING
```

6.5.5.2 Variables

6.5.5.2.1 x

EXPRESS specification:

```
x : SET OF action_directive_relationship;
```

6.5.5.3 Statements

6.5.5.3.1 i

EXPRESS specification:

```
REPEAT i := 1 TO HIINDEX(x);
  IF NOT acyclic_action_directive_relationship(x[i], relatives + relation.relating,
specific_relation) THEN
    RETURN (FALSE);
  END_IF;
END_REPEAT;
```


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