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TECHNICAL CORRIGENDUM 2

Industrial automation systems and integration- Product data representation and exchange - Part 105: Application resource: Kinematics

TECHNICAL CORRIGENDUM 2

Technical Corrigendum 2 to International Standard ISO 10303-105: 1996 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

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Introduction

This document corrects ISO 10303-105:1996, Product data representation and exchange - Part 105: Application resource: Kinematics. The corrected document supersedes ISO 10303-105: 1996 as amended by ISO 10303-105-105:1996/Cor. 1:2000.

The purpose of the modifications to the text of ISO 10303-105: 1996 is to correct errors in the EXPRESS definitions likely to cause compilation problems, to replace the URL in the annex for the computer-interpretable EXPRESS, and to replace the object identifier for the document and the modified schema.

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Modifications to the text of ISO 10303-105: 1996

Clause 5., p. 6

The EXPRESS specification for the kinematic_structure_schema contained logical errors in the reference from for the geometry_schama. Remove the following:

```
REFERENCE FROM geometry_schema
    (axis2_placement_3d,
     cartesian_transformation_operator_3d,
     curve,
     direction,
     geometric_representation_context,
     normalise,
     point,
     point_on_curve,
     point_on_surface,
     surface,
     rectangular_trimmed_surface,
     trimmed_curve);
```

Replace with the following:

```
REFERENCE FROM geometry_schema
    (axis2_placement_3d,
     cartesian_transformation_operator_3d,
     curve,
     direction,
     geometric_representation_context,
     geometric_representation_item,
     normalise,
     point,
     point_on_curve,
     point_on_surface,
     surface,
     rectangular_trimmed_surface,
     trimmed_curve);
```

Clause 5.4.6, p. 17

The EXPRESS specification for mechaism_base_placement had an additional group qualifier for ***WR3:*** *that is not allowed. Remove the EXPRESS specification and replace with the following:*

<u>EXPRESS specification:</u>

```
*)
ENTITY mechanism_base_placement
  SUBTYPE OF (representation_relationship_with_transformation);
  base_of_mechanism         : mechanism;
  SELF\representation_relationship_with_transformation.
    transformation_operator : cartesian_transformation_operator_3d;
DERIVE
  SELF\representation_relationship.rep_2
                 : kinematic_link_representation
                 := representation_of_link (base_of_mechanism.base);
UNIQUE
  UR1: base_of_mechanism;
WHERE
 WR1: ('KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_GROUND_REPRESENTATION' IN
```

```
        TYPEOF (SELF\representation_relationship.rep_1))
      OR
      ('KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_LINK_REPRESENTATION' IN
        TYPEOF (SELF\representation_relationship.rep_1));
  WR2: suitably_based_mechanism (SELF, base_of_mechanism);
  WR3: SELF\representation_relationship_with_transformation.
        transformation_operator IN
      SELF\representation_relationship.rep_1.items;
END_ENTITY;
(*
```

Clause 5.4.12, p. 21

The EXPRESS specification for the kinematic_link_representation had an additional group qualifier for the link_frame attribute that is not allowed. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY kinematic_link_representation
  SUBTYPE OF (representation);
  SELF\representation.context_of_items :
            geometric_representation_context;
DERIVE
  link_frame                  :  geometric_representation_context
                              := SELF\representation.context_of_items;
INVERSE
  link_representation_relation :
        kinematic_link_representation_relation FOR geometric_aspects;
WHERE
  WR1: SIZEOF (QUERY (item <* SELF\representation.items |
              NOT (('KINEMATIC_STRUCTURE_SCHEMA.RIGID_PLACEMENT' IN
                     TYPEOF (item))
                    OR
 ('GEOMETRY_SCHEMA.CARTESIAN_TRANSFORMATION_OPERATOR_3D' IN
                     TYPEOF (item))) )) = 0;
END_ENTITY;
(*
```

Clause 5.4.16, p. 24

The EXPRESS specification for the kinematic_frame_background_representation_association had an additional group qualifier for ***WR3:*** *that is not allowed. Remove the EXPRESS specification and replace with the following:*

EXPRESS specification:

```
*)
ENTITY kinematic_frame_background_representation_association
  SUBTYPE OF (representation_relationship_with_transformation);
  SELF\representation_relationship_with_transformation.
    transformation_operator : kinematic_frame_based_transformation;
WHERE
  WR1: 'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_LINK_REPRESENTATION' IN
        TYPEOF (SELF\representation_relationship.rep_1);
  WR2:
'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_FRAME_BACKGROUND_REPRESENTATION'
        IN TYPEOF (SELF\representation_relationship.rep_2);
  WR3: SELF\representation_relationship_with_transformation.
```

```
transformation_operator\kinematic_frame_based_transformation.
           transformator IN
         SELF\representation_relationship.rep_1.items;
END_ENTITY;
(*
```

Clause 5.4.37, p. 42

The EXPRESS specification for the universal_pair had an additional group qualifier for ***WR1:*** *that is not allowed. Remove the EXPRESS specification and replace with the following:*

EXPRESS specification:

```
*)
ENTITY universal_pair
  SUBTYPE OF (kinematic_pair);
  input_skew_angle : OPTIONAL plane_angle_measure;
DERIVE
  skew_angle  : plane_angle_measure := NVL (input_skew_angle, 0.0);
WHERE
  WR1: COS (plane_angle_for_pair_in_radian (SELF, skew_angle))
       > 0.0;
END_ENTITY;
(*
```

Clause 5.4.68, p. 79

The EXPRESS specification for the rack_and_pinion_pair_value had an additional group qualifier for the actual_rotation attribute that is not allowed. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY rack_and_pinion_pair_value
  SUBTYPE OF (pair_value);
  SELF\pair_value.applies_to_pair : rack_and_pinion_pair;
  actual_displacement             : length_measure;
DERIVE
  actual_rotation : plane_angle_measure
                  := convert_plane_angle_for_pair_from_radian
                     (SELF\pair_value.applies_to_pair,
                      (- actual_displacement /
                       SELF\pair_value.applies_to_pair\
                       rack_and_pinion_pair.pinion_radius));
END_ENTITY;
(*
```

Clause 5.5.3, p. 82

The EXPRESS specification for the suitably_based_mechanism had an additional group qualifier for the klrep and the kgrep variables that is not allowed. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
FUNCTION suitably_based_mechanism (mbp  : mechanism_base_placement;
                                   mech : mechanism) : BOOLEAN;
  LOCAL
    kprop  : kinematic_property_definition;
```

```
    kgrep  : kinematic_ground_representation;
    klrep  : kinematic_link_representation;
    klnk   : kinematic_link;
    kjnts  : BAG OF kinematic_joint;
    nmechs : BAG OF mechanism;
    nmbps  : BAG OF mechanism_base_placement;
  END_LOCAL;

  kprop := mech.containing_property;

  IF ('KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_GROUND_REPRESENTATION' IN
      TYPEOF (mbp\representation_relationship.rep_1)) THEN
      kgrep := mbp\representation_relationship.rep_1;

    IF (kgrep.property\property_definition_representation.definition
        :=: kprop) THEN
      RETURN (TRUE);
    ELSE
      RETURN (FALSE);
    END_IF;
  ELSE
    klrep := mbp\representation_relationship.rep_1;
    klnk   := klrep.link_representation_relation.topological_aspects;
    kjnts  := USEDIN (klnk,
            'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_JOINT.FIRST_LINK') +
              USEDIN (klnk,
            'KINEMATIC_STRUCTURE_SCHEMA.KINEMATIC_JOINT.SECOND_LINK');
    nmechs := USEDIN (kjnts[1].structure,
         'KINEMATIC_STRUCTURE_SCHEMA.MECHANISM.STRUCTURE_DEFINITION');

    IF (nmechs[1] :=: mech) THEN
      RETURN (FALSE);
    ELSE
      IF (nmechs[1].containing_property :<>: kprop) THEN
        RETURN (FALSE);
      ELSE
        nmbps := USEDIN (nmechs[1], 'KINEMATIC_STRUCTURE_SCHEMA.'+
                         'MECHANISM_BASE_PLACEMENT.BASE_OF_MECHANISM');

        IF (SIZEOF (nmbps) = 0) THEN
          RETURN (FALSE);
        ELSE
          RETURN (suitably_based_mechanism (nmbps[1], mech));
        END_IF;
      END_IF;
    END_IF;
  END_IF;
END_FUNCTION;
(*
```

Clause 5.5.6, p. 90

The EXPRESS specification for the frame_associated_to_background had an additional group qualifier for the ass_bag and trm_bag variables that is not allowed in the FUNCTION REPEAT and an additional group qualifier in the definition of the rep_bag variable within the FUNCTION. The ass_bag variable constructor did not ensure that the REPRESENTATION_RELATIONSHIP was of type KINEMATIC_FRAME_BACKGROUND_-REPRESENTATION_ASSOCIATION. The rep_bag had the USEDIN replaced with a QUERY to ensure that the background was in the correct schema. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
FUNCTION frame_associated_to_background
  (frame      : rigid_placement;
   background : kinematic_frame_background) : BOOLEAN;
  LOCAL
    rep_bag : BAG OF kinematic_frame_background_representation;
    trf_bag : BAG OF kinematic_frame_based_transformation;
    trm_bag : BAG OF kinematic_frame_based_transformation;
    ass_bag : BAG OF
              kinematic_frame_background_representation_association;
    rep     : kinematic_frame_background_representation;
    ass     : kinematic_frame_background_representation_association;
  END_LOCAL;

  rep_bag := QUERY ( bg <* USEDIN (background,
                     'KINEMATIC_STRUCTURE_SCHEMA.' +
                     'REPRESENTATION.ITEMS')|
                     'KINEMATIC_STRUCTURE_SCHEMA.'+
                     'KINEMATIC_FRAME_BACKGROUND_REPRESENTATION'
                      IN TYPEOF (bg) );

  IF SIZEOF (rep_bag) = 0 THEN
    RETURN (FALSE);
  END_IF;

  trf_bag := USEDIN (frame,
                     'KINEMATIC_STRUCTURE_SCHEMA.' +
                     'KINEMATIC_FRAME_BASED_TRANSFORMATION.' +
                     'TRANSFORMATOR');

  IF SIZEOF (trf_bag) = 0 THEN
    RETURN (FALSE);
  END_IF;

  REPEAT i := 1 TO HIINDEX (rep_bag);
    rep := rep_bag[i];

ass_bag := QUERY ( kfbra <* USEDIN ( rep,
             'KINEMATIC_STRUCTURE_SCHEMA.' +
             'REPRESENTATION_RELATIONSHIP.REP_2') |
             'KINEMATIC_STRUCTURE_SCHEMA.'+
             'KINEMATIC_FRAME_BACKGROUND_REPRESENTATION_ASSOCIATION'
             IN TYPEOF ( kfbra ) );

    IF SIZEOF (ass_bag) > 0 THEN
      REPEAT j:= 1 TO HIINDEX (ass_bag);
        ass := ass_bag[j];

        trm_bag := QUERY (trm <* trf_bag |
          (trm :=:
           ass\representation_relationship_with_transformation.
           transformation_operator));

        IF SIZEOF (trm_bag) > 0 THEN
          RETURN (TRUE);
        END_IF;
```

```
      END_REPEAT;
    END_IF;
  END_REPEAT;

  RETURN (FALSE);

END_FUNCTION;
(*
```

Clause 5.5.8, p. 94

The EXPRESS specification for the convert_plane_angle_for_pair_from_radian had an OTHERWISE statement in the CASE OF that was not required and caused NULL conditional evaluation that was not correct. Remove the following from the EXPRESS specification:

```
OTHERWISE           : ;
```

Clause 7.4.3, p. 115

The EXPRESS specification for the founded_kinematic_path had an additional group qualifier for the founding attribute that is not allowed. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY founded_kinematic_path
  SUBTYPE OF (representation);
  SELF\representation.items : SET [1 : ?] OF kinematic_path;
  SELF\representation.context_of_items :
       geometric_representation_context;
DERIVE
  paths : SET [1 : ?] OF kinematic_path := SELF\representation.items;
  founding : geometric_representation_context
           := SELF\representation.context_of_items;
END_ENTITY;
(*
```

Clause 7.4.4, p. 116

The EXPRESS specification for the motion_link_relationship had an additional group qualifier for the motion attribute that is not allowed. Remove the EXPRESS specification and replace with the following:

EXPRESS specification:

```
*)
ENTITY motion_link_relationship
  SUPERTYPE OF (ONEOF (prescribed_path, resulting_path))
  SUBTYPE OF (representation_relationship);
  SELF\representation_relationship.rep_1 : founded_kinematic_path;
  SELF\representation_relationship.rep_2 :
       kinematic_link_representation;
       related_frame                    : rigid_placement;
DERIVE
  motion     : founded_kinematic_path
             := SELF\representation_relationship.rep_1;
  frame_link : kinematic_link_representation
             := SELF\representation_relationship.rep_2;
WHERE
```

```
  WR1: related_frame IN frame_link\representation.items;
END_ENTITY;
(*
```

Annex B.1, p. 123

With the changes identified in this Technical Corrigendum, the object identifier for this part of ISO 10303 has changed. Remove the object identifier for the document and replace with the following:

{ iso standard 10303 part (105) version (3) }

Annex B.2.1, p. 123

With the changes identified in this Technical Corrigendum, the object identifier for the kinematic_structure_schema has changed. Remove the object identifier for kinematic_structure_schema and replace with the following:

{ iso standard 10303 part (105) version (3) object (1) kinematic-structure-schema (1) }

Annex B.2.3, p. 123

With the changes identified in this Technical Corrigendum, the object identifier for the kinematic_analysis_control_and_result_schema has changed. Remove the object identifier for kinematic_analysis_control_and_result_schema and replace with the following:

{ iso standard 10303 part (105) version (3) object (1)
kinematic-analysis-control-and-result-schema (3) }

Annex C, p. 124

With the changes identified in this Technical Corrigendum, the EXPRESS contained in digital form is incorrect. Remove the following:

EXPRESS: http://www.mel.nist.gov/step/parts/part105/is/tc1/

Replace with the following:

EXPRESS: http://www.mel.nist.gov/step/parts/part105/is/tc2/