EWIS Interoperability Forum
Test Suite v4.0

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Document History

Release	Date	Change
1.0	2019-09-11	Initial Release
2.0	2020-09-09/11	Update & extended for 2nd test round
3.0	2021-06-16	For the 3rd test round: Adding Connectivity3 and -4 test case. Connectivity1 and 2: - Adding JointType - adding PartTransportFeature for cable, and wire - WireIdentification with definition to PartTransportFeature - fixing CableOccurrenceTerminal replacing attribute LocationGroup by ElementOf
4.0	2021-12-09	For the 4th test round: - updating all test cases for new XML schema from 2021-0916 new WirePartIdentification; previous WireIdentification renamed to WireOccurrenceIdentification; - adding new Connectivity5 test case; - changed test case Connectivity3 to use the new capability for complex connectors to reflect lower level terminals to a higher level - minor fixes in previous test case specifications

Trademarks

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1 Introduction

This document describes the suite of test cases to be used for the EWIS Interoperability Forum. The EWIS-IF is a joint testing forum, organized and facilitated by AFNeT and PDES.

2 Formal Test Syntax

This clause defines a formal syntax for the definition of synthetic test cases in the terms of the Domain Model. Purpose of this syntax is to formulate test cases in a clear, easy readable and unambiguous way. A macro capability allows to define standard patterns once and then apply them again and again. It is intended to convert test cases using this syntax into XML Schematron for the

The formal test syntax allows the definition of patterns of instances of Application Objects (AO); here they are AOs of the Domain Model. The test syntax is used to define the test specifications for both import and export of STEP XML files.

Instances of AOs and other values (string, real, ...) are identified (ID) by a leading “@” followed by a positive number. This number is unique within a particular test case and macro. If the same ID is used several times within a test case or macro, then this means the same AO instance or other value. If the same ID is used in different test cases or macros this does not have any meaning.

Every instance or other value has to have a definition statement. Such a statement starts with the ID, followed by a “:” and then followed by it’s type that is defined in the domain model. After this constraints on the attribute values of instances or the value itself can be stated within “(“...”)”.

The order of IDs within a macro is significantly. They should start with @1, @2, @3 … @N. When invoking a macro from another test case or higher level macro, these IDs are replaced with the IDs and values defined within the macro invocation.

3 Macros

3.1 Part_with_PartView

This macro constraints single instances of a Part, a PartVersion, a PartView and a ViewContext to be linked together. Only the name for a Part is constrained as the ID of a Part is often rather system dependent. The ViewContext used as the initialContext for the PartView is constrained for the predefined LifeCycleStage “design”.

```
Macro Part_with_PartView (
  @1:Part( Name=@2, Versions[i]=@3 );
  @2:CharacterString
  @3:PartVersion( Views[i]=@4 );
  @4:PartView( InitialContext=@5 );
  @5:ViewContext( LifeCycleStage=PredefinedApplicationDomainEnum(design) );
);
```

3.2 Part_with_ID_and_PartView

This macro is similar to the macro Part_with_PartView but instead of constraining the name of a Part the ID of a part is constraint.

```
Macro Part_with_ID_and_PartView (
  @1:Part( Id=@2, Versions=(@3) );
  @2:Identifier;
  @3:PartVersion( Views=(@4) );
```

```
  @4:PartView( InitialContext=@5 );
  @5:ViewContext( LifeCycleStage=PredefinedApplicationDomainEnum(design) );
);
```

3.3 Part_WiringHarnessAssemblyDesign

This macro is similar to the macro Part_with_PartView and constraints single instances of a Part, a PartVersion, a WiringHarnessAssemblyDesign (that is a sub-subytype of PartView) and a ViewContext to be linked together. The Part is constrained for the PartType “wiring_harness”.

```
Macro Part_WiringHarnessAssemblyDesign (
  @1:Part( Name=@2,
           Versions[i]=@3,
           PartTypes[i]=PartCategoryEnum(wiring_harness) );
  @2:CharacterString
  @3:PartVersion( Views[i]=@4 );
  @4:WiringHarnessAssemblyDesign( InitialContext=@5 );
  @5:ViewContext( LifeCycleStage=PredefinedApplicationDomainEnum(design),
            ApplicationDomain=PredefinedApplicationDomainEnum(electrical)
                          );
);
```

3.4 Part_WiringHarnessAssemblyDesign_with_topology

This macro is an extension of the macro Part_WiringHarnessAssemblyDesign. In addition to this it adds a constraint for an additional ViewContext with the predefined LifeCycleStage “wiring_harness_segment_topology”.

```
Macro Part_WiringHarnessAssemblyDesign_with_topology (
  Part_WiringHarnessAssemblyDesign(@1,@2,@3,@4,@5);
  @1:Part;
  @2:CharacterString;
  @3:PartVersion;
  @4:WiringHarnessAssemblyDesign( AdditionalContexts[i]=@6 );
  @5:ViewContext;
  @6:ViewContext( ApplicationDomain=PredefinedApplicationDomainEnum(
         wiring_harness_segment_topology) );
);
```

3.5 Joint2

This macro constrains an *AssemblyDefinition* and two *OccurrenceShapeFeatures* (that belong to *Occurrences* that are brought into the assembly by *NextAssemblyOccurrenceUsage* to be connected by an *AssemblyShapeJoint* with a specified *AssemblyJointTypeEnum* value.

```
Macro Joint2 (
  @1:AssemblyDefinition;
  @2:OccurrenceShapeFeature;
  @3:OccurrenceShapeFeature;
  @4:AssemblyJointTypeEnum;
  @5:AssemblyShapeJoint( ElementOf=@1, JointType=@4 );
  @6:AssemblyShapeJointItemRelationship( Relating=@5, Related=@2 );
  @7:AssemblyShapeJointItemRelationship( Relating=@5, Related=@3 );
);
```

3.6 Undirected_edge

This macro constrains an edge with two vertices so that either one of the Vertices is the EdgeStart and the other Vertices is the EdgeEnd. In STEP all Edges are by default directed, however for the design of the topology of an EWH the direction of an Edge is not relevant (however it might be relevant for the purpose of manufacturing).

```
Macro Undirected_edge (
   @1=Edge( ( EdgeStart=@2, EdgeEnd=@3)
            OR
            ( EdgeStart=@3, EdgeEnd=@2) );
   @2=Vertex;
   @3=Vertex;
);
```

4 Test Case Specifications

4.1 EWH-Assembly1

This test case focuses on a very basic flat assembly structures as it might show up in EWH. This test does not address connectivity or topological information. This test is an extension of the typical assembly structure as provided in the document “Recommended Practices for AP242 Business Object Model XML Assembly Structure”.

The following elements are tested:

- Part with PartCategories: discrete_part, raw_material_by_length, wire, cable, connector, lug
- WiringHarnessAssemblyDesign that is a subtype of AssemblyDefinition
- specific kinds of Part Occurrences: SingleOccurrence, QuantifiedOccurrence, WireOccurrence, CableOccurrence

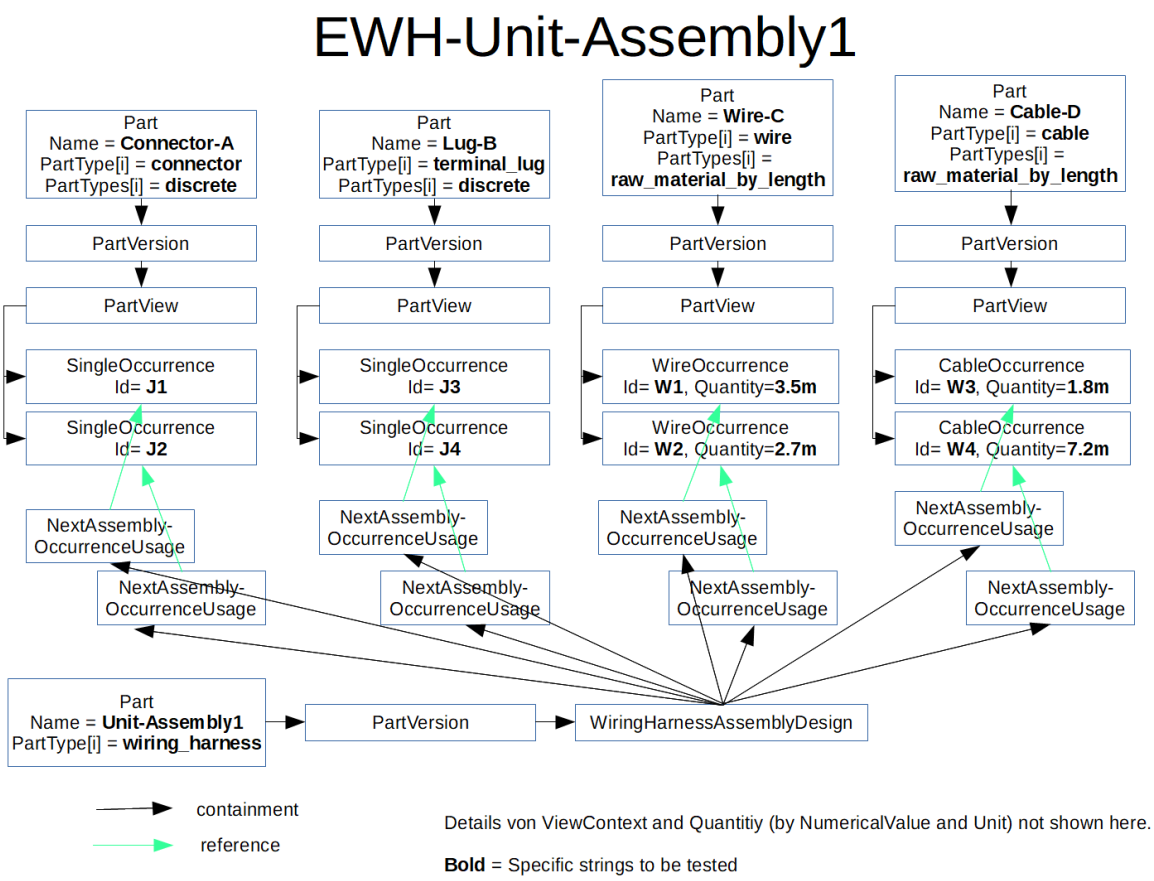

Figure 1: EWH-Assembly1

Formal test-case specification:

```
Test EWH-Assembly1 (

@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@100:Part( PartTypes[i]=PartCategoryEnum(connector), PartTypes[i]=PartCate-
goryEnum(discrete) );
@101:PartVersion;
@102:PartView;
Part_with_Name_and_PartView( @100, "Connector-A", @101, @102, @4);
@111:SingleOccurrence( Id=IdentifierString("J1"), Definition=@102 );
@121:SingleOccurrence( Id=IdentifierString("J2"), Definition=@102 );

@200:Part( PartTypes[i]=PartCategoryEnum(terminal_lug), PartTypes[i]=Part-
CategoryEnum(discrete) );
@201:PartVersion;
@202:PartView;
Part_with_Name_and_PartView(@200, "Lug-B", @201, @202, @4);
@211:SingleOccurrence( Id=IdentifierString("J3"), Definition=@202 );
@221:SingleOccurrence( Id=IdentifierString("J4"), Definition=@202 );

@300:Part( PartTypes[i]=PartCategoryEnum(wire), PartTypes[i]=PartCatego-
ryEnum(raw_material_by_length) );
@301:PartVersion;
```

```
@302:PartView;
Part_with_Name_and_PartView(@300, "Wire-C", @301, @302, @4);
@311:WireOccurrence( Id=IdentifierString("W1"), Definition=@302,
Quantity=@312 );
@312:NumericalValue( Unit=@8, ValueComponent=3.5 );
@321:WireOccurrence( Id=IdentifierString("W2"), Definition=@302,
Quantity=@322 );
@312:NumericalValue( Unit=@8, ValueComponent=2.7 );

@400:Part( PartTypes[i]=PartCategoryEnum(cable), PartTypes[i]=PartCatego-
ryEnum(raw_material_by_length) );
@401:PartVersion;
@402:PartView;
Part_with_Name_and_PartView(@400, "Cable-D", @401, @402, @4);
@411:CableOccurrence( Id=IdentifierString("W3"), Definition=@402,
Quantity=@412 );
@412:NumericalValue( Unit=@8, ValueComponent=1.8 );
@421:CableOccurrence( Id=IdentifierString("W4"), Definition=@402,
Quantity=@422 );
@412:NumericalValue( Unit=@8, ValueComponent=7.2 );

@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign;
@9003:ViewContext;
@9004:ViewContext;
Part_WiringHarnessAssemblyDesign( @9000,"EWH Test-Case
Assembly1",@9001,@9002,@9003,@9004 );

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111 );
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@121 );
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211 );
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@221 );
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311 );
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@321 );
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@411 );
@9108:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@421 );

sizeof(Part) = 5;
sizeof(PartVersion) = 5;
sizeof(PartView) = 4;
sizeof(WiringHarnessAssemblyDesign) = 1;
sizeof(NextAssemblyOccurrenceUsage) = 8;
sizeof(SingleOccurrence) = 4;
sizeof(WireOccurrence) = 2;
sizeof(CableOccurrence) = 2;

);
```

4.2 EWH-Topology1

This test case focuses on a very basic topological structure needed for EWH without any other information. The test consists of a flexible topological/geometric representation of the harness, consisting of 6 vertices and 5 edges with length.

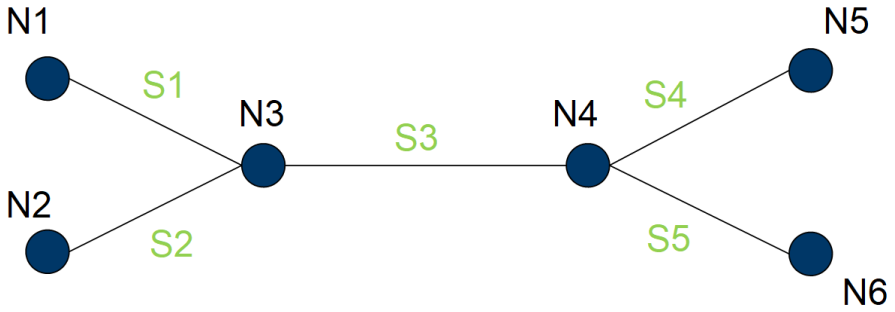

Figure 2: EWH-Topology1

Formal test-case specification:

```
Test EWH-Topology1 (

@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign( Topology=@9901 );
@9003:ViewContext;
@9004:ViewContext;
Part_WiringHarnessAssemblyDesign_with_topology(@9000,
  "EWH Test-Case Topology1",@9001,@9002,@9003,@9004);

@9900:GeometricCoordinateSpace( Units=@8, DimensionCount=1 );
@9901:EdgeBasedTopologicalRepresentationWithLengthConstraint(
 Items=(@9902), ContextOfItems=@9900 );
@9902:ConnectedEdgeSet( ConnectedEdges=(@9931,@9932,@9933,@9934,@9935) );

@9911:Point();
@9912:Point();
@9913:Point();
@9914:Point();
@9915:Point();
@9916:Point();

@9921:VertexPoint( name='N1' VertexGeometry=@9911 );
@9922:VertexPoint( name='N2' VertexGeometry=@9912 );
@9923:VertexPoint( name='N3' VertexGeometry=@9913 );
@9924:VertexPoint( name='N4' VertexGeometry=@9914 );
@9925:VertexPoint( name='N5' VertexGeometry=@9915 );
@9926:VertexPoint( name='N6' VertexGeometry=@9916 );

@9931:EdgeBoundedCurveWithLength( name='S1', EdgeGeometry=@9941 );
undirected_edge(@9931, @9921, @9923)
@9932:EdgeBoundedCurveWithLength( name='S2', EdgeGeometry=@9942 );
undirected_edge(@9932, @9922, @9923)
@9933:EdgeBoundedCurveWithLength( name='S3', EdgeGeometry=@9943 );
undirected_edge(@9933, @9923, @9924);
@9934:EdgeBoundedCurveWithLength( name='S4', EdgeGeometry=@9944 );
undirected_edge(@9934, @9924, @9925);
```

```
@9935:EdgeBoundedCurveWithLength( name='S5', EdgeGeometry=@9945 );
undirected_edge(@9935,@9924,@9926);

@9941:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(2.0) );
@9942:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(4.0) );
@9943:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(6.0) );
@9944:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(8.0) );
@9945:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(10.0) );

sizeof(Part) = 1;
sizeof(PartVersion) = 1;
sizeof(WiringHarnessAssemblyDesign) = 1;
sizeof(NextAssemblyOccurrenceUsage) = 0;

sizeof(GeometricCoordinateSpace) = 1;
sizeof(EdgeBasedTopologicalRepresentationWithLengthConstraint) = 1;
sizeof(ConnectedEdgeSet) = 1;
sizeof(BoundedCurveWithLength) = 5;
sizeof(EdgeBoundedCurveWithLength) = 5;
sizeof(VertexPoint) = 6;
sizeof(Point) = 6;
sizeof(CartesianPoint) = 0;
sizeof(PointOnCurve) = 0;

);
```

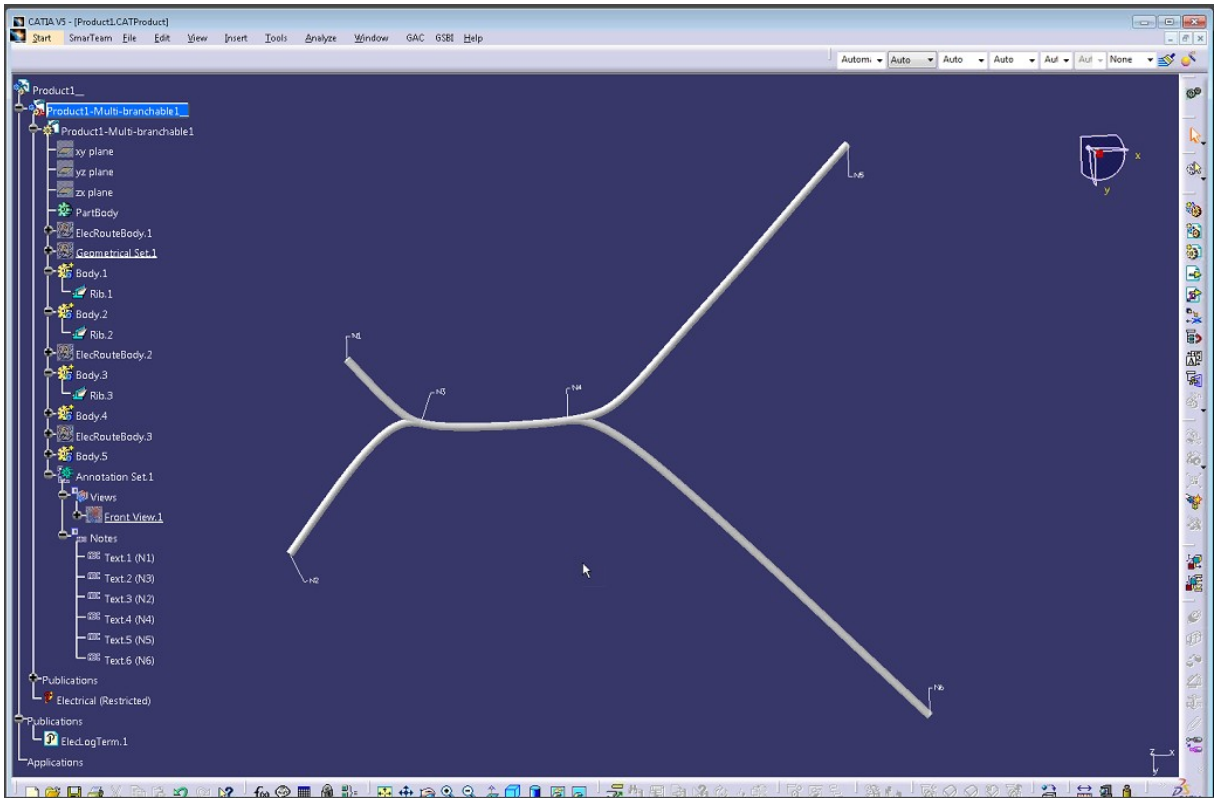

Figure 3: Example in CATIA

Provided test files:

AP242ed2 XML: EWH-UseCase-Topology1.xml

Native CATIA: Topology Test1 - Sample CatiaV5 STP.zip

Mentor/Siemens Capital Harness: Topology Test1 - Sample Capital HX2ML.xml

KBL, generated from Capital Harness:

Topology Test1 - Sample Capital KBL_2.3.kbl

Topology Test1 - Sample Capital KBL2.4.kbl

4.3 EWH-Topology2

This test case is an extension of test case EWH-Topology1 that is merged with a simplified EWH-Assembly1 test case.

- the topology model is extended for Paths, SubEdges and PointOnCurves
  - Path P1 traverses the EdgeBoundedCurveWithLength S1, S3, S4
  - Path P2 traverses the EdgeBoundedCurveWithLength S2, S3, S5
  - Path P3 traverses the SubEdges S2.2, S3.1
  - for the definition of the VertexPoints for the SubEdges, two PointOnCurves are defined in the middle of the underlying BoundedCurveWithLength
  - it is up to the implementations to ensure that the orientations of the Edges in the EdgeList of a Path fits with the orientation of the underlying BoundedCurveWith-Length. See the attributes *Path.OrientationList* and *EdgeCurve.SameSense* for this purpose.
- the simplified assembly structure consists of
  - a single wire
  - a single cable
  - a protective covering for only a certain region
- two simple 2-pin connectors and two terminal lugs; one at each extremity of the harness topology
- geometry-to-topology association of
  - wire/cable/protection *Occurrences* to *Paths*
  - connectors and terminal lug *Occurrences* to *VertexPoints*

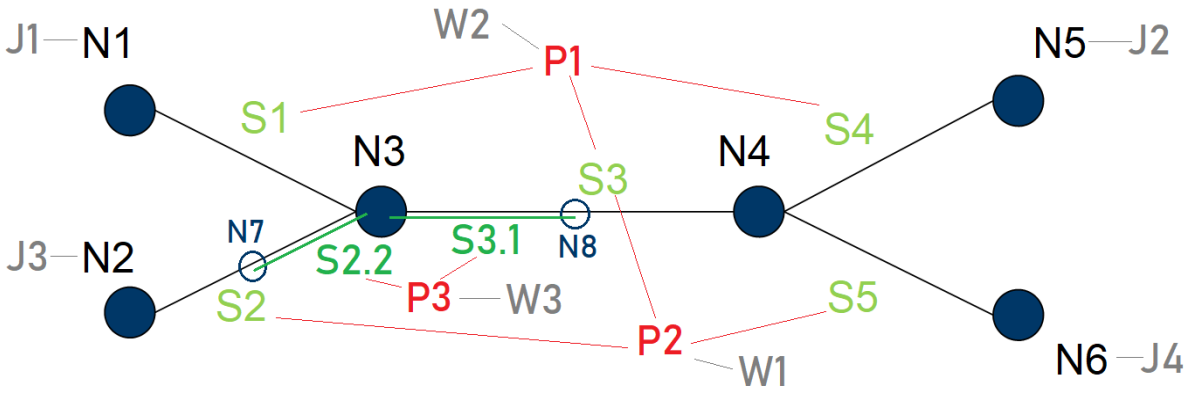

Figure 4: EWH-Topology2

Formal test-case specification:

(Draft; not completed yet; references depends on the available p21 files)

```
Test EWH-Topology2 (

@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@100:Part( PartTypes[i]=PartCategoryEnum(connector),
           PartTypes[i]=PartCategoryEnum(discrete) );
@101:PartVersion;
@102:PartView( DefiningGeometry=@191 );
Part_with_Name_and_PartView( @100, "Connector-A", @101, @102, @4);
@111:SingleOccurrence( Id=IdentifierString("J1"), Definition=@102 );
@121:SingleOccurrence( Id=IdentifierString("J2"), Definition=@102 );
@190:GeometricCoordinateSpace( DimensionCount=3 );
@191:GeometricModel( items[i]=@192, ContextOfItems=@190 );
@192:AxisPlacement;

@200:Part( PartTypes[i]=PartCategoryEnum(terminal_lug),
           PartTypes[i]=PartCategoryEnum(discrete) );
@201:PartVersion;
@202:PartView( DefiningGeometry=@291 );
Part_with_Name_and_PartView(@200, "Lug-B", @201, @202, @4);
@211:SingleOccurrence( Id=IdentifierString("J3"), Definition=@202 );
@221:SingleOccurrence( Id=IdentifierString("J4"), Definition=@202 );
@290:GeometricCoordinateSpace( DimensionCount=3 );
@291:GeometricModel( items[i]=@292, ContextOfItems=@290 );
@292:AxisPlacement;

@300:Part( PartTypes[i]=PartCategoryEnum(wire),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@301:PartVersion;
@302:PartView( DefiningGeometry=@391 );
Part_with_Name_and_PartView(@300, "Wire-C", @301, @302, @4);
@311:WireOccurrence( Id=IdentifierString("W1"),
  Definition=@302, Quantity=@312 );
@312:NumericalValue( Unit=@8, ValueComponent=3.5 );
@390:GeometricCoordinateSpace( DimensionCount=2 );
@391:GeometricModel( name='2D cross section',
  items[i]=@392, ContextOfItems=@390 );
@392:AxisPlacement; # placeholder for 2D centre

@400:Part( PartTypes[i]=PartCategoryEnum(cable),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@401:PartVersion;
@402:PartView( DefiningGeometry=@491 );
Part_with_Name_and_PartView(@400, "Cable-D", @401, @402, @4);
@411:CableOccurrence( Id=IdentifierString("W2"), Definition=@402,
Quantity=@412 );
@412:NumericalValue( Unit=@8, ValueComponent=1.8 );
@490:GeometricCoordinateSpace( DimensionCount=2 );
@491:GeometricModel( name='cross section', items[i]=@492,
ContextOfItems=@490 );
@492:AxisPlacement;
```

```
@500:Part( PartTypes[i]=PartCategoryEnum(protective_covering),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@501:PartVersion;
@502:PartView( DefiningGeometry=@591 );
Part_with_Name_and_PartView(@500, "Protection-E", @501, @502, @4);
@511:QuantifiedOccurrence( Id=IdentifierString("W3"),
                           Definition=@402, Quantity=@412 );
@512:NumericalValue( Unit=@8, ValueComponent=1.2 );
@590:GeometricCoordinateSpace( DimensionCount=2 );
@591:GeometricModel( name='cross section',
                     items[i]=@592, ContextOfItems=@590 );
@592:AxisPlacement;

@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign( Topology=@9901 );
@9003:ViewContext;
@9004:ViewContext;
Part_WiringHarnessAssemblyDesign_with_topology(@9000,
  "EWH Test-Case Topology2",@9001,@9002,@9003,@9004);

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111,
                                   Placement=(@9111) ); # connector J1
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@121,
                                   Placement=(@9112) ); # connector J2
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211,
                                   Placement=(@9113) ); # terminal lug J3
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@221,
                                   Placement=(@9114) ); # terminal lug J4
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311,
                                   Placement=(@9115 ) ); # wire W1
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@411,
                                   Placement=(@9116 ) ); # cable W2
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@511,
                                   Placement=(@9117 ) ); # protection W3

@9111:GeometryToTopologyModelAssociation (
  Relating=@9901, Related=@191, Origin=@192, Target=@9921); # connector J1
@9112:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@191, Origin=@192, Target=@9925); # connector J2
@9113:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@291, Origin=@292, Target=@9922); # terminal lug
J3
@9114:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@291, Origin=@292, Target=@9926); # terminal lug
J4
@9115:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@391, Origin=@392, Target=@9952); # wire W1
@9116:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@491, Origin=@492, Target=@9951); # cable W2
@9117:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@591, Origin=@493, Target=@9953); # protection W3
```

```
@9900:GeometricCoordinateSpace( Units=@8, DimensionCount=1 );
@9901:EdgeBasedTopologicalRepresentationWithLengthConstraint(
  Items=(@9902,@9951,@9952,@9953), # the ConnectedEdgeSet + paths
  ContextOfItems=@9900 );
@9902:ConnectedEdgeSet( ConnectedEdges=(@9931,@9932,@9933,@9934,@9935) );
  # only main edges, not sub-edges

@9911:Point();
@9912:Point();
@9913:Point();
@9914:Point();
@9915:Point();
@9916:Point();
@9917:PointOnCurve( BasicCurve=@9942, Parameter=2.0 );
  # in the middle of the basic curve
@9918:PointOnCurve( BasicCurve=@9943, Parameter=3.0 );
  # in the middle of the basic curve

@9921:VertexPoint( name='N1', VertexGeometry=@9911 );
@9922:VertexPoint( name='N2', VertexGeometry=@9912 );
@9923:VertexPoint( name='N3', VertexGeometry=@9913 );
@9924:VertexPoint( name='N4', VertexGeometry=@9914 );
@9925:VertexPoint( name='N5', VertexGeometry=@9915 );
@9926:VertexPoint( name='N6', VertexGeometry=@9916 );
@9927:VertexPoint( name='N7', VertexGeometry=@9917 );
@9928:VertexPoint( name='N8', VertexGeometry=@9918 );

@9931:EdgeBoundedCurveWithLength( name='S1', EdgeGeometry=@9941 );
undirected_edge(@9931, @9921, @9923)
@9932:EdgeBoundedCurveWithLength( name='S2', EdgeGeometry=@9942 );
undirected_edge(@9932, @9922, @9923)
@9933:EdgeBoundedCurveWithLength( name='S3', EdgeGeometry=@9943 );
undirected_edge(@9933, @9923, @9924);
@9934:EdgeBoundedCurveWithLength( name='S4', EdgeGeometry=@9944 );
undirected_edge(@9934, @9924, @9925);
@9935:EdgeBoundedCurveWithLength( name='S5', EdgeGeometry=@9945 );
undirected_edge(@9935,@9924,@9926);
@9936:SubEdge( name='S2.2', ParentEdge=@9932 );
undirected_edge(@9936,@9927,@9923);
@9937:SubEdge( name='S3.1', ParentEdge=@9933);
undirected_edge(@9937,@9923,@9928);

@9941:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(2.0) );
  # for S1
@9942:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(4.0) );
  # for S2
@9943:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(6.0) );
  # for S3
@9944:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(8.0) );
  # for S4
@9945:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(10.0) );
  # for S5
```

```
# vendors to ensure that the edge are oriented in correct way
@9951:Path( name="P1", EdgeList=(@9931,@9933,@9934) ); # S1+S3+S4
@9952:Path( name="P2", EdgeList=(@9932,@9933,@9935) ); # S2+S3+S5
@9953:Path( name="P3", EdgeList=(@9936,@9937) );       # S2.2+S3.1

sizeof(Part) = 6;
sizeof(PartVersion) = 6;
sizeof(PartView) = 5;
sizeof(WiringHarnessAssemblyDesign) = 1;
sizeof(NextAssemblyOccurrenceUsage) = 7;
sizeof(SingleOccurrence) = 4;
sizeof(WireOccurrence) = 1;
sizeof(CableOccurrence) = 1;

sizeof(GeometricCoordinateSpace) = 1;
sizeof(EdgeBasedTopologicalRepresentationWithLengthConstraint) = 1;
sizeof(ConnectedEdgeSet) = 1;
sizeof(BoundedCurveWithLength) = 5;
sizeof(EdgeBoundedCurveWithLength) = 5;
sizeof(VertexPoint) = 8;
sizeof(Point) = 6;
sizeof(CartesianPoint) = 0;
sizeof(PointOnCurve) = 2;
sizeof(SubEdge) = 2;
sizeof(Path) = 3;

);
```

4.4 EWH-Topology3

This test case is an extension of the content in EWH-Topology2 for:

- external references into p21 files:
  - complete p21 files for discrete parts "Connector-A" and "Lug-B"
  - element reference into p21 file for centre-curves and axis-placements
- topology-to-geometry association

This test case is likely to be refined later on as the topic of XML “external element references” is new to the community of STEP implementers, and there are no final recommended practices yet for this area (need common work with CAX-IF and PDM-IF). So even if only a subset of the below gets implemented would already be a success.

Formal test-case specification:

```
Test EWH-Topology3 (

@9:FormatProperty( DataFormat="ISO 10303-242", CharacterCode="ISO 8859-
1" );

@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@100:Part( PartTypes[i]=PartCategoryEnum(connector),
           PartTypes[i]=PartCategoryEnum(discrete) );
```

```
@101:PartVersion;
@102:PartView( DefiningGeometry=@191 );
Part_with_Name_and_PartView( @100, "Connector-A", @101, @102, @4);
@111:SingleOccurrence( Id=IdentifierString("J1"), Definition=@102 );
@121:SingleOccurrence( Id=IdentifierString("J2"), Definition=@102 );
@190:GeometricCoordinateSpace( DimensionCount=3, Items=(@192) );
@191:ExternalGeometricModel( items=(@192), ContextOfItems=@190,
       ExternalFile=@193  ); # was GeometricModel in EWH-Topology2
@192:AxisPlacement( Position=(0.0, 0.0, 0.0) ); # Axis and RefDirection de-
faults
  # alternatively use ExternalRepresentationItem to select placement in p21
file
@193:DigitalFile( FileLocations=@194, FileFormat=@9, exists(Id) ); #
id=file name

@200:Part( PartTypes[i]=PartCategoryEnum(terminal_lug),
           PartTypes[i]=PartCategoryEnum(discrete) );
@201:PartVersion;
@202:PartView( DefiningGeometry=@291 );
Part_with_Name_and_PartView(@200, "Lug-B", @201, @202, @4);
@211:SingleOccurrence( Id=IdentifierString("J3"), Definition=@202 );
@221:SingleOccurrence( Id=IdentifierString("J4"), Definition=@202 );
@290:GeometricCoordinateSpace( DimensionCount=3, Items=(@192) );
@291:ExternalGeometricModel( Items=(@292), ContextOfItems=@290,
  ExternalFile=@293  ); # was GeometricModel in EWH-Topology2
@292:AxisPlacement( Position=(0.0, 0.0, 0.0) ); # Axis and RefDirection de-
faults
@293:DigitalFile( FileLocations=@294, FileFormat=@9, exists(Id) ); #
id=file name

@300:Part( PartTypes[i]=PartCategoryEnum(wire),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@301:PartVersion;
@302:PartView( DefiningGeometry=@391 );
Part_with_Name_and_PartView(@300, "Wire-C", @301, @302, @4);
@311:WireOccurrence( Id=IdentifierString("W1"),
  Definition=@302, Quantity=@312 );
@312:NumericalValue( Unit=@8, ValueComponent=3.5 );
@390:GeometricCoordinateSpace( DimensionCount=2 );
@391:GeometricModel( name='2D cross section',
  items[i]=@392, ContextOfItems=@390 );
@392:AxisPlacement; # placeholder for 2D centre

@400:Part( PartTypes[i]=PartCategoryEnum(cable),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@401:PartVersion;
@402:PartView( DefiningGeometry=@491 );
Part_with_Name_and_PartView(@400, "Cable-D", @401, @402, @4);
@411:CableOccurrence( Id=IdentifierString("W2"), Definition=@402,
Quantity=@412 );
@412:NumericalValue( Unit=@8, ValueComponent=1.8 );
@490:GeometricCoordinateSpace( DimensionCount=2 );
@491:GeometricModel( name='cross section', items[i]=@492,
ContextOfItems=@490 );
```

```
@492:AxisPlacement;

@500:Part( PartTypes[i]=PartCategoryEnum(protective_covering),
           PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@501:PartVersion;
@502:PartView( DefiningGeometry=@591 );
Part_with_Name_and_PartView(@500, "Protection-E", @501, @502, @4);
@511:QuantifiedOccurrence( Id=IdentifierString("W3"),
                           Definition=@402, Quantity=@412 );
@512:NumericalValue( Unit=@8, ValueComponent=1.2 );
@590:GeometricCoordinateSpace( DimensionCount=2 );
@591:GeometricModel( name='cross section',
                     items[i]=@592, ContextOfItems=@590 );
@592:AxisPlacement;

@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign(
  Topology=@9901, DefiningGeometry=@9201  );
@9003:ViewContext;
@9004:ViewContext;
Part_WiringHarnessAssemblyDesign_with_topology(@9000,
  "EWH Test-Case Topology3",@9001,@9002,@9003,@9004);

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111,
  Placement=(@9111,@9801) ); # connector J1
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@121,
  Placement=(@9112,@9802) ); # connector J2
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211,
  Placement=(@9113,@9803) ); # terminal lug J3
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@221,
  Placement=(@9114,@9804) ); # terminal lug J4
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311,
  Placement=(@9115) ); # wire W1
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@411,
  Placement=(@9116) ); # cable W2
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@511,
  Placement=(@9117) ); # protection W3

@9111:GeometryToTopologyModelAssociation (
  Relating=@9901, Related=@191, Origin=@192, Target=@9921); # connector J1
@9112:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@191, Origin=@192, Target=@9925); # connector J2
@9113:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@291, Origin=@292, Target=@9922); # terminal lug
J3
@9114:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@291, Origin=@292, Target=@9926); # terminal lug
J4
@9115:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@391, Origin=@392, Target=@9952); # wire W1
@9116:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@491, Origin=@492, Target=@9951); # cable W2
```

```
@9117:GeometryToTopologyRepresentationAssociation(
  Relating=@9901, Related=@591, Origin=@493, Target=@9953); # protection W3

@9200:GeometricCoordinateSpace( Units=@8, DimensionCount=3 );
@9201:ComposedGeometricModel( ContextOfItems=@9200;
Items=(@9211,@9212,@9213,@9214) );
  # contains the connectors and multi-branchable
@9211=AxisPlacement; # alternativel ExternalRepresentationItem from p21
files
@9212=AxisPlacement;
@9213=AxisPlacement;
@9214=AxisPlacement;
@9801:GeometricRepresentationRelationshipWithPlacementTransformation(
  origin=@192, target=@9211,
  relating=@9201, related=@191, Definitional=TRUE ); # connector J1
@9802:GeometricRepresentationRelationshipWithPlacementTransformation(
  origin=@192, target=@9212,
  relating=@9201, related=@191, Definitional=TRUE ); # connector J2
@9803:GeometricRepresentationRelationshipWithPlacementTransformation(
  origin=@292, target=@9213,
  relating=@9201, related=@292, Definitional=TRUE ); # terminal lug J3
@9804:GeometricRepresentationRelationshipWithPlacementTransformation(
  origin=@292, target=@9214,
  relating=@9201, related=@292, Definitional=TRUE ); # terminal lug J4
@9808:GeometricRepresentationRelationshipWithSameCoordinateSpace(
  relating=@9201, related=@9211, Definitional=TRUE ); # for stuff in the
multi-branchable

@9210:DigitalFile( FileFormat=@9, FileFormat=@9, exisit(Id) ); # Id=name of
p21 file
@9211:ExternalGeometricModel( items=(@9212,@9213,@9214,@9215),
  ContextOfItems=@9200, ExternalFile=@9210 ); # multi-branchable
@9220:AxisPlacement;
@9221:ExternalRepresentationItem( External=@9231 );
@9222:ExternalRepresentationItem( External=@9232 );
@9223:ExternalRepresentationItem( External=@9233 );
@9224:ExternalRepresentationItem( External=@9234 );
@9225:ExternalRepresentationItem( External=@9235 );
@9226:ExternalRepresentationItem( External=@9236 );
@9227:ExternalRepresentationItem( External=@9237 );

# for the following instance the ID attribute must be set
# corresponding to an anchor or instance-id in the target p21 file
@9231:ExternalEntityInstance( exist(Id), Source=@9210 );
@9232:ExternalEntityInstance( exist(Id), Source=@9210 );
@9223:ExternalEntityInstance( exist(Id), Source=@9210 );
@9224:ExternalEntityInstance( exist(Id), Source=@9210 );
@9225:ExternalEntityInstance( exist(Id), Source=@9210 );
@9226:ExternalEntityInstance( exist(Id), Source=@9210 ); # curve for S2.2
@9227:ExternalEntityInstance( exist(Id), Source=@9210 ); # curve for S3.1

# Alternative for @9226 and @9227
# use PointOnCurve with PARAMETER given in p21 file and
# construct a new curve in XML to associat to
```

```
@9299:TopologyToGeometryModelAssociation( Relating=@9201, Related=@9901,
  # order of pairs: connector J1, ... J2, terminal lug J3, ... J4, edges
S1..S5, S2.2, S3.1
  # maybe instead of paths we have to map single EdgeBoundedCurveWithLength
   Origin=(@9921,@9925,@9922,@9926, @9931,@9932,@9933,@9934,@9935,
@9936,@9937),
   Target=(@9211,@9212,@9213,@9214, @9221,@9222,@9223,@9224,@9225,
@9226,@9227) );

@9900:GeometricCoordinateSpace( Units=@8, DimensionCount=1 );
@9901:EdgeBasedTopologicalRepresentationWithLengthConstraint(
  Items=(@9902,@9951,@9952,@9953), # the ConnectedEdgeSet + paths
  ContextOfItems=@9900 );
@9902:ConnectedEdgeSet( ConnectedEdges=(@9931,@9932,@9933,@9934,@9935) );
  # only main edges, not sub-edges

@9911:Point();
@9912:Point();
@9913:Point();
@9914:Point();
@9915:Point();
@9916:Point();
@9917:PointOnCurve( BasicCurve=@9942, Parameter=2.0 );
  # in the middle of the basic curve
@9918:PointOnCurve( BasicCurve=@9943, Parameter=3.0 );
  # in the middle of the basic curve

@9921:VertexPoint( name='N1', VertexGeometry=@9911 );
@9922:VertexPoint( name='N2', VertexGeometry=@9912 );
@9923:VertexPoint( name='N3', VertexGeometry=@9913 );
@9924:VertexPoint( name='N4', VertexGeometry=@9914 );
@9925:VertexPoint( name='N5', VertexGeometry=@9915 );
@9926:VertexPoint( name='N6', VertexGeometry=@9916 );
@9927:VertexPoint( name='N7', VertexGeometry=@9917 );
@9928:VertexPoint( name='N8', VertexGeometry=@9918 );

@9931:EdgeBoundedCurveWithLength( name='S1', EdgeGeometry=@9941 );
undirected_edge(@9931, @9921, @9923)
@9932:EdgeBoundedCurveWithLength( name='S2', EdgeGeometry=@9942 );
undirected_edge(@9932, @9922, @9923)
@9933:EdgeBoundedCurveWithLength( name='S3', EdgeGeometry=@9943 );
undirected_edge(@9933, @9923, @9924);
@9934:EdgeBoundedCurveWithLength( name='S4', EdgeGeometry=@9944 );
undirected_edge(@9934, @9924, @9925);
@9935:EdgeBoundedCurveWithLength( name='S5', EdgeGeometry=@9945 );
undirected_edge(@9935,@9924,@9926);
@9936:SubEdge( name='S2.2', ParentEdge=@9932 );
undirected_edge(@9936,@9927,@9923);
@9937:SubEdge( name='S3.1', ParentEdge=@9933);
undirected_edge(@9937,@9923,@9928);

@9941:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(2.0) );
```

```
  # for S1
@9942:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(4.0) );
  # for S2
@9943:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(6.0) );
  # for S3
@9944:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(8.0) );
  # for S4
@9945:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(10.0) );
  # for S5

# vendors to ensure that the edge are oriented in correct way
@9951:Path( name="P1", EdgeList=(@9931,@9933,@9934) ); # S1+S3+S4
@9952:Path( name="P2", EdgeList=(@9932,@9933,@9935) ); # S2+S3+S5
@9953:Path( name="P3", EdgeList=(@9936,@9937) );       # S2.2+S3.1

);
```

4.5 EWH-Connectivity1

This test case consists of a WiringHarnessAssemblyDesign that is composed of

- a terminal lug “LUG01” that is defined by Part “640903-1” with a single terminal “1”
- a connector “PLUG01” that is defined by Part “RCA123” with terminals “0” and “1”
- a connector “P-CONN01” that is defined by Part “IMC16-2002X” with terminals “1” and “2”
- a cable “CABLE01” that is defined by Part “9962 009100” with two wires, one black and the other white
- a wire “WIRE01” that is defined by Part “83027 001100”
- the two connectors are joint to the two ends of the cable.
- the single wire connects LUG01 with terminal “1” of “PLUG01”

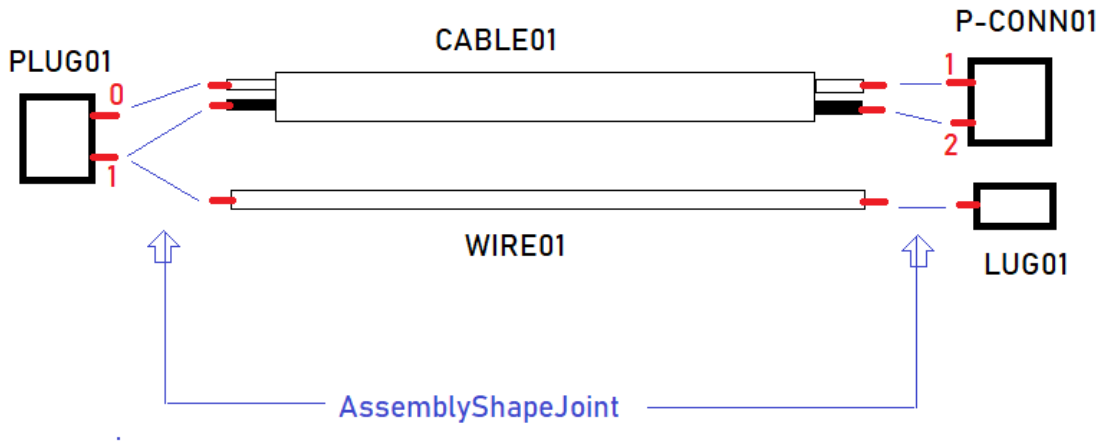

Figure 5: EWH-Connectivity1

Formal test-case specification:

```
Test EWH-Connectivity1 (
```

```
@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@50:Organization( name="MIL ...??")
@51:Organization( name="Deutch Company Ltd ...")
@52:Organization( name="BELDEN company ...")
@60:Identifier( Id=IdentifierString("Standard RCA connector") )

@70:WireColourBasedIdentificationCode( Id="white" );
@71:WireColourBasedIdentificationCode( Id="black" );

# Terminal Lug
@100:Part( PartTypes[i]=PartCategoryEnum(terminal_lug),
  PartTypes[i]=PartCategoryEnum(discrete) );
@101:PartVersion;
@102:PartView;
@103:Identifier( Id=IdentifierString("640903-1"), IdentificationContext=@50
)
Part_with_ID_and_PartView(@100, @103, @101, @102, @4);
@104:PartTerminal( ElementOf=@102, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@111:SingleOccurrence( Id=IdentifierString("LUG01"), Definition=@102 );
@112:OccurrenceTerminal( ElementOf=@111, Definition=@104 );

# Connector with integrated contacts
@200:Part( PartTypes[i]=PartCategoryEnum(connector), PartTypes[i]=PartCate-
goryEnum(discrete) );
@201:PartVersion;
@202:PartView;
@203:Identifier( Id=IdentifierString("RCA123"), IdentificationContext=@60 )
Part_with_ID_and_PartView(@200, @203, @201, @202, @4);
@204:PartTerminal( ElementOf=@202, Id="0", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@205:PartTerminal( ElementOf=@202, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@211:SingleOccurrence( Id=IdentifierString("PLUG01"), Definition=@202 );
  @214:OccurrenceTerminal( ElementOf=@211, Definition=@204 );
  @215:OccurrenceTerminal( ElementOf=@211, Definition=@205 );

# Simplified model for Deutch connector with direct PartTerminals
@300:Part( PartTypes[i]=PartCategoryEnum(connector), PartTypes[i]=PartCate-
goryEnum(discrete) );
@301:PartVersion;
@302:PartView;
@303:Identifier( Id=IdentifierString("IMC16-2002X"),
IdentificationContext=@51 )
Part_with_ID_and_PartView(@300, @303, @301, @302, @4);
@306:PartTerminal( ElementOf=@302, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@307:PartTerminal( ElementOf=@302, Id="2", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@311:SingleOccurrence( Id=IdentifierString("P-CONN01"), Definition=@302 );
```

```
#316:OccurrenceTerminal( ElementOf=@311, Definition=@306 );
#317:OccurrenceTerminal( ElementOf=@311, Definition=@307 );

# Cable
@500:Part( PartTypes[i]=PartCategoryEnum(cable), PartTypes[i]=PartCatego-
ryEnum(raw_material_by_length) );
@501:PartVersion;
@502:PartView;
@503:Identifier( Id=IdentifierString("9962 009100"),
IdentificationContext=@52 )
Part_with_ID_and_PartView(@500, @503, @501, @502, @4);
@504:WirePartIdentification( ElementOf=@502, Id="CABLE01-WHT", code=@70 );
@505:WirePartIdentification( ElementOf=@502, Id="CABLE01-BLK", code=@71 );
@511:CableOccurrence( Id=IdentifierString("CABLE01"), Definition=@502,
Quantity=@512 );
  @512:NumericalValue( Unit=@8, ValueComponent=1.8 );
  @513:WireOccurrenceIdentification( ElementOf=@511, Id="CABLE01-WHT", Def-
inition=@504 );
  @514:WireOccurrenceIdentification( ElementOf=@511, Id="CABLE01-BLK", Def-
inition=@505 );
  @515:CableOccurrenceTerminalLocationGroup( ElementOf=@511, Name="end
a" );
    @521:CableOccurrenceTerminal( ElementOf=@515, AssociatedTransportFea-
ture=@513 );
    @523:CableOccurrenceTerminal( ElementOf=@515, AssociatedTransportFea-
ture=@514 );
  @516:CableOccurrenceTerminalLocationGroup( ElementOf=@511, Name="end
b" );
    @522:CableOccurrenceTerminal( ElementOf=@516, AssociatedTransportFea-
ture=@513 );
    @524:CableOccurrenceTerminal( ElementOf=@516, AssociatedTransportFea-
ture=@514 );

# Wire
@600:Part( PartTypes[i]=PartCategoryEnum(wire),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@601:PartVersion;
@602:PartView;
@603:Identifier( Id=IdentifierString("83027 001100"), IdentificationCon-
text=@52 )
Part_with_ID_and_PartView(@600, @603, @601, @602, @4);
@611:WireOccurrence( Id=IdentifierString("WIRE01"), Definition=@602, Quan-
tity=@612 );
@612:NumericalValue( Unit=@8, ValueComponent=3.5 );
@613=WireOccurrenceIdentification( ElementOf=@611,
DomainType="electrical" ... )
@614=WireOccurrenceTerminal( ElementOf=@611,
AssociatedTransportFeature=@613,
  Name="end a" );
@615=WireOccurrenceTerminal( ElementOf=@611,
AssociatedTransportFeature=@613,
  Name="end b" );

# EWH-Assembly
@9000:Part;
```

```
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign;
@9003:ViewContext;
Part_WiringHarnessAssemblyDesign( @9000,
  "EWH Test-Case Connectivity1",@9001,@9002,@9003 );

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111 );
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211 );
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311 );
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@511 );
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@611 );

# connections
@9210:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9211:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@214 );
# PLUG01 / 0
  @9212:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@521 );
# CABLE01-WHT / end a
@9220:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection"  );
  @9221:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@316 );
# P-CONN01 / 01
  @9222:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@522 );
# CABLE01-WHT / end b
@9230:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection"  );
  @9231:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@215 );
# PLUG01 / 1
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@523 );
# CABLE01-BLK / end a
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@614 );
# WIRE01 / end a
@9240:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection"  );
  @9241:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@317 );
# P-CONN01 / 02
  @9242:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@524 );
# CABLE01-BLK / end a
@9250:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection"  );
  @9251:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@112 );
# LUG01 / 1
  @9252:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@615 );
# WIRE01 / end b

sizeof(Part) = 6;
sizeof(PartVersion) = 6;
sizeof(PartView) = 5;
sizeof(WiringHarnessAssemblyDesign) = 1;
sizeof(NextAssemblyOccurrenceUsage) = 5;
sizeof(SingleOccurrence) = 3;
sizeof(WireOccurrence) = 1;
sizeof(CableOccurrence) = 1;
```

```
sizeof(PartTerminal) = 5; # only the join terminals
sizeof(OccurrenceTerminal) = 5; # only the join terminals
sizeof(WireColourBasedIdentificationCode) = 2;
sizeof(WireOccurrenceTerminal) = 2;
sizeof(CableOccurrenceTerminalLocationGroup) = 2;
sizeof(CableOccurrenceTerminal) = 4;
sizeof(AssemblyShapeJoint) = 5;
sizeof(AssemblyShapeJointItemRelationship) = 11;

);
```

4.6 EWH-Connectivity2

This test case is very similar to the test case EWH-Connectivity1. The difference is that the connector “P-CONN01” is now modeled more realistically. There is no direct terminal but instead there are the two cavities “1” and “2” for two separate connector contacts:

- a terminal lug “LUG01” that is defined by Part “640903-1” with a single terminal “1”
- a connector “PLUG01” that is defined by Part “RCA123” with terminals “0” and “1”
- a connector “P-CONN01” that is defined by Part “IMC16-2002X” with cavities “1” and “2”
- two connector contacts "P-CONN01-01" and "P-CONN01-02" that are defined by Part "6860-201-20278" that fits into the cavities of a connector of type “IMC16-2002X”. Each of the connector contacts has a single join terminal.
- a cable “CABLE01” that is defined by Part “9962 009100” with two wires, one black and the other white
- a wire “WIRE01” that is defined by Part “83027 001100”
- connector “PLUG01” is joint to one ends of the cable, and the two connector contacts are joint to the other end. The connector contacts are then inserted into connector “PLUG01”
- the single wire connects LUG01 with terminal “1” of “PLUG01”

Initial input data from users to this test:

Part Number	Occurrence (REFDES)	Terminals	Description	Images
640903-1	LUG01	1	MIL standard Receptacle (similar to Lug)	
RCA123	PLUG01	0 1	Standard RCA plug (Or Cinch) https://en.wikipedia.org/wiki/RCA_connector	
IMC16-2002X	P-CONN01		Deutch waterproof connector with two cavities	
6860-201-20278	P-CONN01-01 P-CONN01-02		Deutch Plug Contact	
9962 009100			BELDEN Cable	
83027 001100			BELDEN Wire	

Table 1: Original part list for connectivity test

From	From Pin	Wire Name	Material	To	To Pin
PLUG01	0	CABLE01-WHT	9962 009100	P-CONN01	P-CONN01-01
PLUG01	1	CABLE01-BLK	9962 009100	P-CONN01	P-CONN01-02
PLUG01	1	WIRE01	83027 001100	LUG01	

Table 2: Original wire list for connectivity test

Adaptions on the original input data to be used by AP242-EWH:

- the cavities of the connector “IMC16-2002X” are not numbered, but they are in the Deutsch documentation indicated with “1” and “2”. It is essential to not mix them up;
- no terminals are defined for the connector contact “6860-201-20278”, but of course there is an implicit join-terminal (for crimping) and an interface-terminal for the external connection (the later one is not covered here);
- there is no explicit information which connector contact P-CONN01-01/-02 goes into the cavities 1/2 of the connector. This can only be derived from the naming. For

AP242-EWH it is essential to state which connector-contact is inserted into which cavity of the connector (by AssemblyShapeJoint);

- the wire list indicates two connections onto the PLUG01/1 pin. For AP242-EWH this is handled by a triple AssemblyShapeJoint of PLUG01/1 with the cable and single wire terminals.

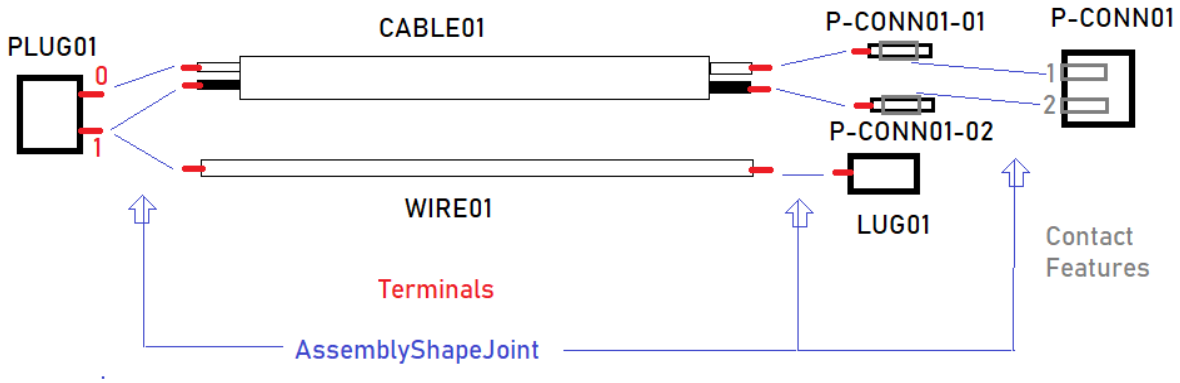

Figure 6: EWH-Connectivity2

For the AssemblyShapeJoints the following JointTypes are to be used:

- JointType="soldered_connection" for the electrical joints on PLUG01 and LUG01;
- JointType="crimped_connection" for the electrical connections of P-CONN01-01/-02 with the cable;
- JointType="snap_connection" for the mechanical connection of P-CONN01-01/-02 with P-CONN01.

Formal test-case specification:

```
Test EWH-Connectivity2 (

@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@50:Organization( name="MIL ...??")
@51:Organization( name="Deutch Company Ltd ...")
@52:Organization( name="BELDEN company ...")
@60:Identifier( Id=IdentifierString("Standard RCA connector") )

@70:WireColourBasedIdentificationCode( Id="white" );
@71:WireColourBasedIdentificationCode( Id="black" );


# Terminal Lug
@100:Part( PartTypes[i]=PartCategoryEnum(terminal_lug),
  PartTypes[i]=PartCategoryEnum(discrete) );
@101:PartVersion;
@102:PartView;
@103:Identifier( Id=IdentifierString("640903-1"),
  IdentificationContext=@50 )
Part_with_ID_and_PartView(@100, @103, @101, @102, @4);
```

```
@104:PartTerminal( ElementOf=@102, Id="1", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
@111:SingleOccurrence( Id=IdentifierString("LUG01"), Definition=@102 );
  @112:OccurrenceTerminal( ElementOf=@111, Definition=@104 );

# Connector with integrated contacts
@200:Part( PartTypes[i]=PartCategoryEnum(connector),
  PartTypes[i]=PartCategoryEnum(discrete) );
@201:PartVersion;
@202:PartView;
@203:Identifier( Id=IdentifierString("RCA123"),
  IdentificationContext=@60 )
Part_with_ID_and_PartView( @200, "", @201, @202, @4);
@204:PartTerminal( ElementOf=@202, Id="0", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" ); # or left, right m GND ?
@205:PartTerminal( ElementOf=@202, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@211:SingleOccurrence( Id=IdentifierString("PLUG01"), Definition=@202 );
  @214:OccurrenceTerminal( ElementOf=@211, Definition=@204 );
  @215:OccurrenceTerminal( ElementOf=@211, Definition=@205 );

# Realistic model for Deutsch connector with cavities
@300:Part( PartTypes[i]=PartCategoryEnum(connector),
  PartTypes[i]=PartCategoryEnum(discrete) );
@301:PartVersion;
@302:PartView;
@303:Identifier( Id=IdentifierString("IMC16-2002X"),
  IdentificationContext=@51 )
Part_with_ID_and_PartView( @300, @303, @301, @302, @4);
@306:PartContactFeature( ElementOf=@302, Id="1", PartDefinition=@1001 );
@307:PartContactFeature( ElementOf=@302, Id="2", PartDefinition=@1001 );
@311:SingleOccurrence( Id=IdentifierString("P-CONN01"), Definition=@302 );
  #316:OccurrenceContactFeature( ElementOf=@311, Definition=@306 );
  #317:OccurrenceContactFeature( ElementOf=@311, Definition=@307 );

# Contact for Deutsch connector
@400:Part( PartTypes[i]=PartCategoryEnum(connector_contact),
  PartTypes[i]=PartCategoryEnum(discrete) );
@401:PartVersion;
@402:PartView;
@403:Identifier( Id=IdentifierString("6860-201-20278"),
  IdentificationContext=@51 )
Part_with_ID_and_PartView( @400, @403, @401, @402, @4);
@406:PartTerminal( ElementOf=@402, Id="j", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@407:PartContactFeature( ElementOf=@402, Id="o", PartDefinition=@1002 );
@411:SingleOccurrence( Id=IdentifierString("P-CONN01-01"),
Definition=@402 );
  @412:OccurrenceTerminal( ElementOf=@411, Definition=@406 );
  @413:OccurrenceContactFeature( ElementOf=@411, Definition=@407 );
@421:SingleOccurrence( Id=IdentifierString("P-CONN01-02"),
Definition=@402 );
  @422:OccurrenceTerminal( ElementOf=@421, Definition=@406 );
```

```
  @423:OccurrenceContactFeature( ElementOf=@421, Definition=@407 );

# Cable
@500:Part( PartTypes[i]=PartCategoryEnum(cable),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@501:PartVersion;
@502:PartView;
@503:Identifier( Id=IdentifierString("9962 009100"),
IdentificationContext=@52 )
Part_with_Name_and_PartView(@500, "Cable-D", @501, @502, @4);
@504:WirePartIdentification( ElementOf=@503, Id="CABLE01-WHT", code=@70 );
@505:WirePartIdentification( ElementOf=@503, Id="CABLE01-BLK", code=@71 );
@511:CableOccurrence( Id=IdentifierString("CABLE01"), Definition=@502,
Quantity=@512 );
  @512:NumericalValue( Unit=@8, ValueComponent=1.8 );
  @513:WireOccurrenceIdentification( ElementOf=@511, Id="CABLE01-WHT", Def-
inition=@504 );
  @514:WireOccurrenceIdentification( ElementOf=@511, Id="CABLE01-BLK", Def-
inition=@505 );
  @515:CableOccurrenceTerminalLocationGroup( ElementOf=@511, Name="end
a" );
    @521:CableOccurrenceTerminal( ElementOf=@515, AssociatedTransportFea-
ture=@513 );
    @523:CableOccurrenceTerminal( ElementOf=@515, AssociatedTransportFea-
ture=@514 );
  @516:CableOccurrenceTerminalLocationGroup( ElementOf=@511, Name="end
b" );
    @522:CableOccurrenceTerminal( ElementOf=@516, AssociatedTransportFea-
ture=@513 );
    @524:CableOccurrenceTerminal( ElementOf=@516, AssociatedTransportFea-
ture=@514 );

# Wire
@600:Part( PartTypes[i]=PartCategoryEnum(wire),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@601:PartVersion;
@602:PartView;
@603:Identifier( Id=IdentifierString("83027 001100"),
  IdentificationContext=@52 )
Part_with_Name_and_PartView(@600, "Wire-C", @601, @602, @4);
@611:WireOccurrence( Id=IdentifierString("WIRE01"), Definition=@602,
  Quantity=@612 );
@612:NumericalValue( Unit=@8, ValueComponent=3.5 );
@613=WireOccurrenceIdentification( ElementOf=@611,
DomainType="electrical" ... )
@614=WireOccurrenceTerminal( ElementOf=@611,
  AssociatedTransportFeature=@613, Name="end a" );
@615=WireOccurrenceTerminal( ElementOf=@611,
  AssociatedTransportFeature=@613, Name="end b" );

# Deutsch IMC Series cavity & contact shapes
@1000:ContactFeatureDefinitionFitRelationship( Name="Deutsch IMC Series
Size 20 fit",
  Relating=@1001, Related=@1002 );
@1001:ContactFeatureDefinition( Name="Deutsch IMC Series Size 20 cavity",
```

```
  ShapeFeatureType=cavity_profile );
@1002:ContactFeatureDefinition( Name="Deutsch IMC Series Size 20 pin",
  ShapeFeatureType=contact_profile );

# EWH-Assembly
@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign;
@9003:ViewContext;
Part_WiringHarnessAssemblyDesign( @9000,"EWH Test-Case Connectivity2",
  @9001,@9002,@9003 );

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111 );
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211 );
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311 );
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@411 ); # "P-
CONN01-01"
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@421 ); # "P-
CONN01-02"
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@511 );
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@611 );

# electrical connections
@9210:AssemblyShapeJoint( ElementOf=@9002,
JointType="soldered_connection" );
  @9211:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@214 );
# PLUG01 / 0
  @9212:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@521 );
# CABLE01-WHT / end a
@9220:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9221:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@412 );
# P-CONN01-01 / j
  @9222:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@522 );
# CABLE01-WHT / end b
@9230:AssemblyShapeJoint( ElementOf=@9002,
JointType="soldered_connection" );
  @9231:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@215 );
# PLUG01 / 1
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@523 );
# CABLE01-BLK / end a
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@614 );
# WIRE01 / end a
@9240:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9241:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@422 );
#  P-CONN01-02 / j
  @9242:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@524 );
# CABLE01-BLK / end b
@9250:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9251:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@112 );
# LUG01 / 1
  @9252:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@615 );
# WIRE01 / end b
```

```
# mechanical connections
@9260:AssemblyShapeJoint( ElementOf=@9002, JointType="snap_connection" );
  @9261:AssemblyShapeJointItemRelationship( Relating=@9260, Related=@316 );
# P-CONN01 / 1
  @9262:AssemblyShapeJointItemRelationship( Relating=@9260, Related=@317 );
# P-CONN01-01 / o
@9270:AssemblyShapeJoint( ElementOf=@9002, JointType="snap_connection" );
  @9271:AssemblyShapeJointItemRelationship( Relating=@9270, Related=@112 );
# P-CONN01 / 2
  @9272:AssemblyShapeJointItemRelationship( Relating=@9270, Related=@423 );
# P-CONN01-02 / o

sizeof(Part) = 7;
sizeof(PartVersion) = 7;
sizeof(PartView) = 6;
sizeof(WiringHarnessAssemblyDesign) = 1;
sizeof(NextAssemblyOccurrenceUsage) = 7;
sizeof(SingleOccurrence) = 5;
sizeof(WireOccurrence) = 1;
sizeof(CableOccurrence) = 1;

sizeof(PartTerminal) >= 4; # there might me interface terminals
sizeof(OccurrenceTerminal) >= 4; # there might me interface terminals
sizeof(PartContactFeature) = 3;
sizeof(OccurrenceContactFeature) = 4;
sizeof(WireColourBasedIdentificationCode) = 2;
sizeof(WireOccurrenceTerminal) = 2;
sizeof(CableOccurrenceTerminalLocationGroup) = 2;
sizeof(CableOccurrenceTerminal) = 4;
sizeof(AssemblyShapeJoint) = 7;
sizeof(AssemblyShapeJointItemRelationship) = 15;

);
```

4.7 EWH-Connectivity3

This test case consists of a “simple” coaxial cable with two coaxial connectors at the ends. The design is an extract from a bigger commercial product. The used parts are:

- coaxial connector **TC-400-SM-X** from Times Microwave Systems
  https://www.timesmicrowave.com/Products/Connectors/TC-400-SM-X/
- coaxial cable **PFLX400-500** from Rockwell Collins
  https://www.collinsaerospace.com/what-we-do/Business-Aviation/Flight-Deck/Avionics-Integration/Avionics-Integration-Products/Cables-And-Connectors/50-And-75-Ohm-Coaxial-And-Triaxial-Cables

FROM REF DES	TERM HRDWR	SHLD/TWST	FEP	WIRE NUMBER	TO REF DES	TERM HARDWR	TEP	WIRE PART NBR	LGTH
180A13P3-1	06-672-17	088-1CX1	ST	F48A-4	212DB06P1P3B -1	06-672-17	ST	PFLX400-500	279.79
180A13P3-C/S	FERRULE	088-1CX1	SC	088-1CX1	212DB06P1P3B -C/S	FERRULE	SC	PFLX400-500	279.79
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

Figure 7: EWH-Connectivity3 - Wire-list

Figure 7 list the inner core and the shield. The mapping of the columns to AP242 is:

- 1, 6: the from and to reference designators are composed by the *SingleOccurrence-Id* and the *Part/OccurrenceTerminal-Id*.
- 2, 7: the terminal hardware to which the connection is established. Below these *Parts* are identified as TC-400-SM-X_contact_pin and TC-400-SM-X_ferrule to have a consistent naming.
- 3: *CableOccurrence-Id*
- 4, 8: The From and To End Preparation. AP242ed2 does not provide explicit details for wire/cable end preparation, but support the kind of *AssemblyShapeJoints* to be used
  - ST – Strip and Tin, specified by *JointType soldered_connection*
  - SC – Strip and Crimp, specified by *JointType crimped_connection*
- 5: the *WireIdentification-Id* within the cable
- 9: the cable *Part-Id*
- 10: the length of the *CableOccurrence* in inch

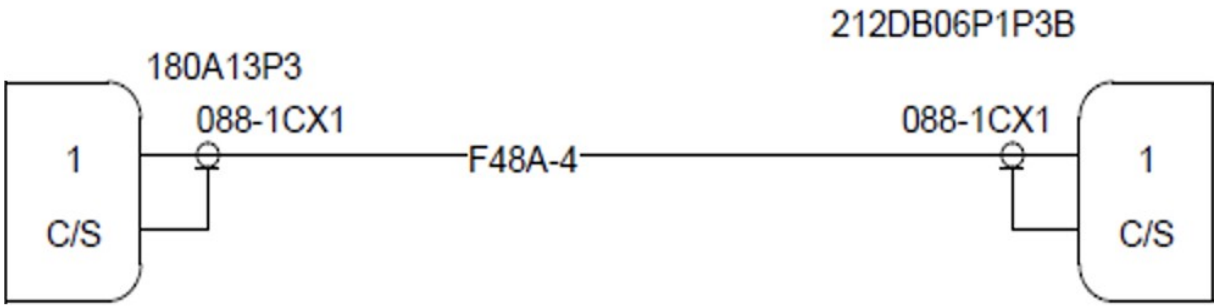

Figure 8: EWH-Connectivity3 - Wiring diagram

4.7.1 Coaxial Connector Model

Some systems might represent the coaxial connector as a simple piece part with two join terminals (core and shield). The focus of this test case is however to represent the coaxial connector as a (sub) ***AssemblyDefinition*** *(@102), consisting* of five pieces (named CONTACT PIN, INSULATOR, BODY, FERRULE and SHELL):

- The CONTACT PIN has a joint and an interface terminal that are internally connected by a ***PartConnectivityDefinition***
- The BODY has a joint and an interface terminal that are internally connected by a PartConnectivityDefinition
- ***SingleOccurrences*** of all five parts (CONTACT PIN, INSULATOR, BODY, FERRULE and SHELL) are assembled with ***NextAssemblyOccurrenceUsages***.
- The ***AssemblyDefinition*** *(@102)* has two join terminals that are reflected back to the OccurrenceTerminals of the SingleOccurrences for the CONTACT PIN and BODY.

The example chosen for this test case is the TC-400-SM-X BNC connector (@100). It is of a male type and suitable to be used for an LMR-400 coax cable (@600). The connector consists of five piece parts named and categorized as:

- body / connector_housing: @200,
- contact pin / connector_contact: @300,
- insulator / <no predefined part category available> : @400,
- shell / backshell: @500,
- ferrule / cable_ferrule: @600.

Because the connector is delivered as a kit, there are no individual part numbers supplied for the piece parts; so we have to make up part numbers for this test case.

The electrical *AssemblyShapeJoints* of the coaxial connector to an end of a coaxial cable is realized by the *JointType* soldered_connection for the coaxial core and by the *JointType crimped_connection* for the crimped_connection.

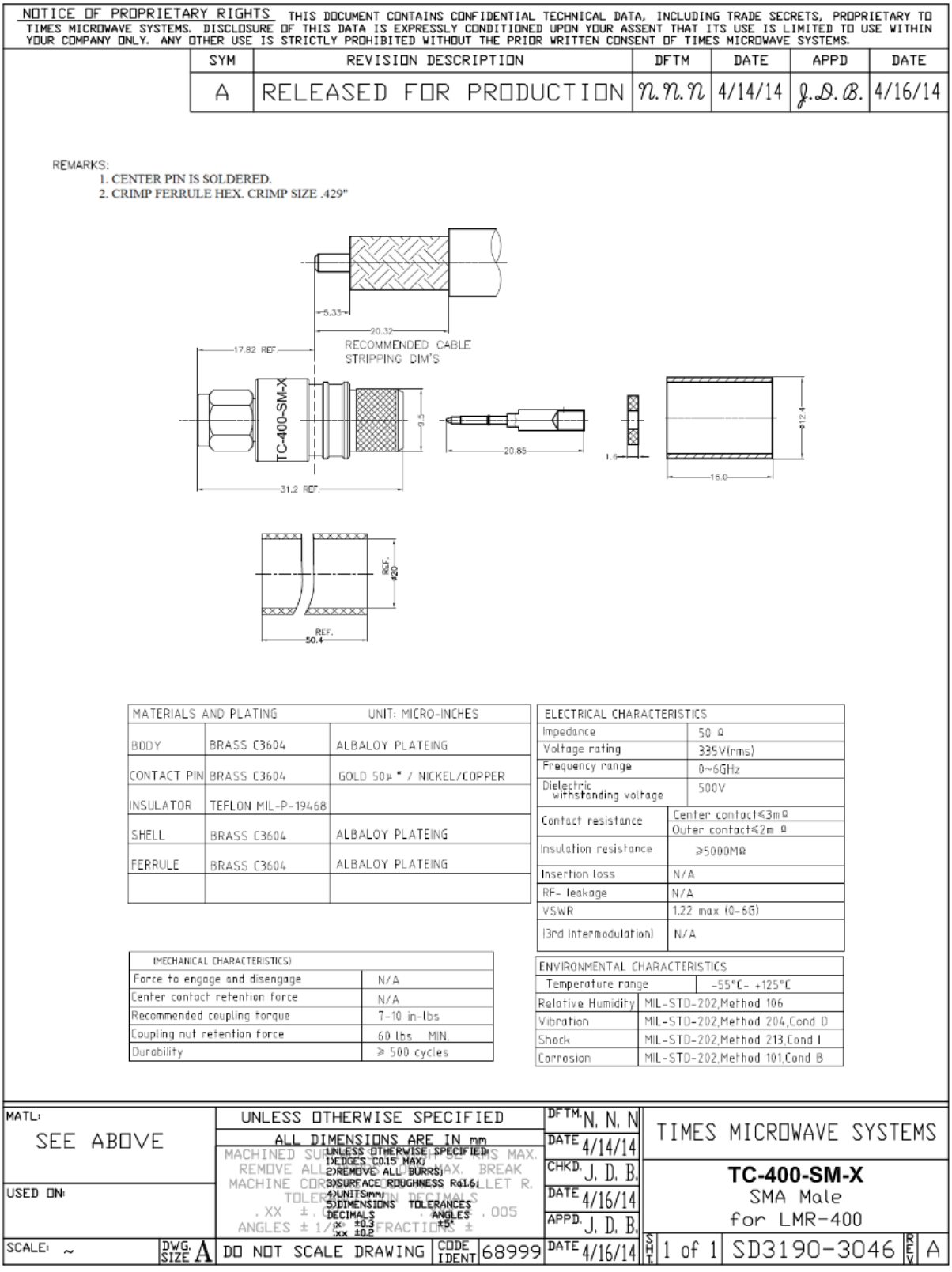

Figure 9: Datasheet of Coax Connector TC-400-SM-X

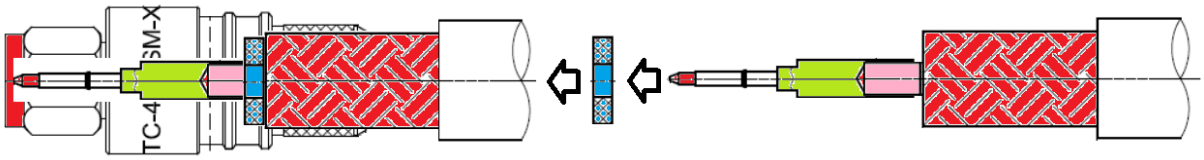

Figure 10: Connector contact inserted into connector shell

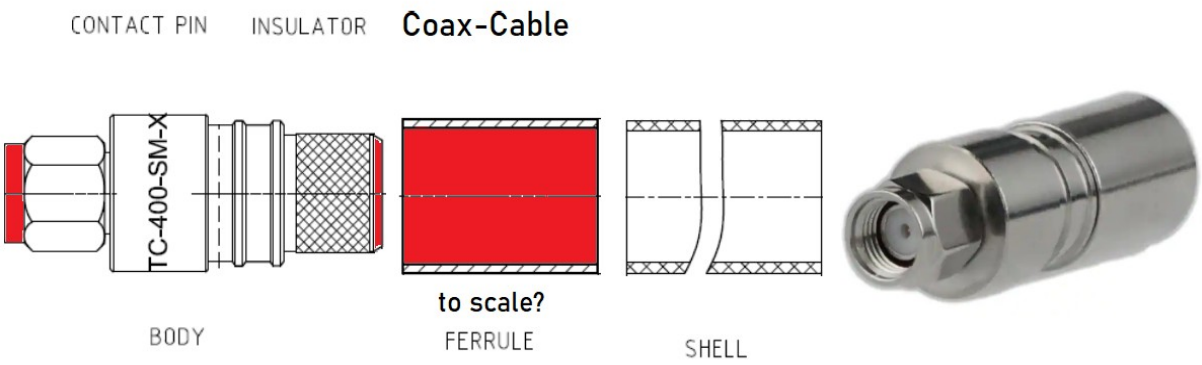

Figure 10: Electrical contacts in red, mechanical contacts in green

General references:

- TC-400-SM-X
  - https://www.timesmicrowave.com/Products/Connectors/TC-400-SM-X
    with 3D STEP files as single piece part
  - https://eu.mouser.com/ProductDetail/Amphenol-Times-Microwave-Systems/TC-400-SM-X?qs=OTrKUuiFdkYP4uoBuXBVRA==
  - https://eu.mouser.com/datasheet/2/18/3190-3046A-1826531.pdf
  - https://www.digikey.com/en/products/detail/amphenol-times-microwave-systems/TC-400-SM-X/9644101
- PFLX400-500RF coaxial cable
  - https://www.collinsaerospace.com/-/media/project/collinsaerospace/collinsaerospace-website/product-assets/marketing/0-9/50-75-ohm-coaxial-cables/1_50-74-coaxial-cables/30_pflx400-500_rf_coaxial_cable_datasheet.pdf?rev=a569a39747e94bbdb1b5ee7995cacd5d&hash
  - https://www.pasternack.com/50-ohm-low-loss-flexible-lmr400-pe-jacket-double-shielded-black-lmr-400-p.aspx

Formal test-case specification:

```
Test EWH-Connectivity3 (

@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("inch"), Quantity=ClassString("length") );

@50:Organization( name="Times Microwaves System")
@52:Organization( name="Rockwell Collins")

@70:WireColourBasedIdentificationCode( Id="core" );
@71:WireColourBasedIdentificationCode( Id="shield" );
```

```
# Connector TC-400-SM-X
@100:Part( Name="RF Connectors",
  Description="Coaxial Connectors SMA-Male (plug) crimp connector; no braid
trim"
  PartTypes[i]=PartCategoryEnum(shielded_connector),
  PartTypes[i]=PartCategoryEnum(connector_kit),
  PartTypes[i]=PartCategoryEnum(connector),
  PartTypes[i]=PartCategoryEnum(discrete) );
@101:PartVersion;
#
# Mandatory assembly view needed to represent the structure of the coaxial
connector
@102:AssemblyDefinition;
@103:Identifier( Id=IdentifierString("TC-400-SM-X"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@100, @103, @101, @102, @4);
#
# interface aspects of assembly
@104:PartTerminal( ElementOf=@102, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal", PartDefinition=@312 );
@105:PartTerminal( ElementOf=@102, Id="C/S", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal", PartDefinition=@212 );

# occurrence level
@111:SingleOccurrence( Id=IdentifierString("connector 1"),
Definition=@102 ); # connector 1
  @112:OccurrenceTerminal( ElementOf=@111, Definition=@104 );
  @113:OccurrenceTerminal( ElementOf=@111, Definition=@105 );
@121:SingleOccurrence( Id=IdentifierString("connector 2"),
Definition=@102 ); # connector 2
  @122:OccurrenceTerminal( ElementOf=@111, Definition=@104 );
  @123:OccurrenceTerminal( ElementOf=@111, Definition=@105 );

# internal sub-assembly aspects of assembly
@162:NextAssemblyOccurrenceUsage( Relating=@102, Related=@211 ); # body /
connector_housing
@163:NextAssemblyOccurrenceUsage( Relating=@102, Related=@311 ); # pin /
connector_contact
@164:NextAssemblyOccurrenceUsage( Relating=@102, Related=@411 ); # insula-
tor
@165:NextAssemblyOccurrenceUsage( Relating=@102, Related=@511 ); # shell /
backshell
@166:NextAssemblyOccurrenceUsage( Relating=@102, Related=@611 ); #
ferrule / cable_ferrule

# Connector housing
@200:Part(
  PartTypes[i]=PartCategoryEnum(connector_housing),
  PartTypes[i]=PartCategoryEnum(discrete) );
@201:PartVersion;
@202:PartView;
@203:Identifier( Id=IdentifierString("TC-400-SM-X_body"), Identification-
Context=@50 )
Part_with_ID_and_PartView(@200, @203, @201, @202, @4);
@204:PartTerminal( ElementOf=@202, Id="C/S", DomainType="electrical",
```

```
  InterfaceOrJoinTerminal="join_terminal" );
# @205 and @206 are optional. They are not needed for this test case
@205:PartTerminal( ElementOf=@202, Id="it", DomainType="electrical",
  InterfaceOrJoinTerminal="interface_terminal" );
@206:PartConnectivityDefinition( ConnectedTerminals=(@204, @205) );
#
@211:SingleOccurrence( Id=IdentifierString("housing"), Definition=@202 );
  @212:OccurrenceTerminal( ElementOf=@211, Definition=@204 );

# Connector contact-pint
@300:Part(
  PartTypes[i]=PartCategoryEnum(connector_contact),
  PartTypes[i]=PartCategoryEnum(discrete) );
@301:PartVersion;
@302:PartView;
@303:Identifier( Id=IdentifierString("TC-400-SM-X_contact_pin"), Identifi-
cationContext=@50 )
Part_with_ID_and_PartView(@300, @303, @301, @302, @4);
@304:PartTerminal( ElementOf=@302, DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
# @305 and @306 are optional. They are not needed for this test case
@305:PartTerminal( ElementOf=@302, DomainType="electrical",
  InterfaceOrJoinTerminal="interface_terminal" );
@306:PartConnectivityDefinition( ConnectedTerminals=(@304, @305) );
#
@311:SingleOccurrence( Id=IdentifierString("???"), Definition=@302 );
  @312:OccurrenceTerminal( ElementOf=@311, Definition=@304 );

# Connector insulator
@400:Part(
  PartTypes[i]=PartCategoryEnum(discrete) );
@401:PartVersion;
@402:PartView;
@403:Identifier( Id=IdentifierString("TC-400-SM-X_insulator"), Identifica-
tionContext=@50 )
Part_with_ID_and_PartView(@400, @403, @401, @402, @4);
@411:SingleOccurrence( Id=IdentifierString("???"), Definition=@402 );

# Connector shell
@500:Part(
  PartTypes[i]=PartCategoryEnum(backshell),
  PartTypes[i]=PartCategoryEnum(discrete) );
@501:PartVersion;
@502:PartView;
@503:Identifier( Id=IdentifierString("TC-400-SM-X_shell"), Identification-
Context=@50 )
Part_with_ID_and_PartView(@500, @503, @501, @502, @4);
@511:SingleOccurrence( Id=IdentifierString("???"), Definition=@502 );

# Connector ferrule
@600:Part(
  PartTypes[i]=PartCategoryEnum(cable_ferrule),
  PartTypes[i]=PartCategoryEnum(discrete) );
```

```
@601:PartVersion;
@602:PartView;
@603:Identifier( Id=IdentifierString("TC-400-SM-X_ferrule"), Identifica-
tionContext=@50 )
Part_with_ID_and_PartView(@600, @603, @601, @602, @4);
@611:SingleOccurrence( Id=IdentifierString("???"), Definition=@602 );

# Cable
@700:Part(
  PartTypes[i]=PartCategoryEnum(cable),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@701:PartVersion;
@702:PartView;
@703:Identifier( Id=IdentifierString("PFLX400-500"),
IdentificationContext=@52 )
Part_with_ID_and_PartView(@700, @703, @701, @702, @4);
@704:WirePartIdentification( ElementOf=@503, Id="core", code=@70 );
@705:WirePartIdentification( ElementOf=@503, Id="shield", code=@71 );
@711:CableOccurrence( Id=IdentifierString("088-1CX1"), Definition=@702,
Quantity=@712 );
  @712:NumericalValue( Unit=@8, ValueComponent=279.79 );
  @713:WireOccurrenceIdentification( ElementOf=@711, Id="F48A-4", Defini-
tion=@704 );
  @714:WireOccurrenceIdentification( ElementOf=@711, Id="088-1CX1", Defini-
tion=@705 );
  @715:CableOccurrenceTerminalLocationGroup( ElementOf=@711, Name="end
a" );
    @721:CableOccurrenceTerminal( ElementOf=@715, AssociatedTransportFea-
ture=@713); # cable1/core / end a
    @723:CableOccurrenceTerminal( ElementOf=@715, AssociatedTransportFea-
ture=@714); # cable1/shield / end a
  @716:CableOccurrenceTerminalLocationGroup( ElementOf=@711, Name="end
b" );
    @722:CableOccurrenceTerminal( ElementOf=@716, AssociatedTransportFea-
ture=@713); # cable1/core / end b
    @724:CableOccurrenceTerminal( ElementOf=@716, AssociatedTransportFea-
ture=@714); # cable1/shield / end a

# EWH-Assembly
@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign;
@9003:ViewContext;
Part_WiringHarnessAssemblyDesign( @9000,
  "EWH Test-Case Connectivity3",@9001,@9002,@9003 );
@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111 );  # Sin-
gleOccurrence "connector 1"
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@121 );  # Sin-
gleOccurrence "connector 2"
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@711 );  # Ca-
bleOccurrence "088-1CX1"
@9210:AssemblyShapeJoint( ElementOf=@9002,
JointType="soldered_connection" );
  @9211:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@112 );
# connector 1/ 1
```

```
  @9212:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@721 );
# 088-1CX1/core / end a
@9220:AssemblyShapeJoint( ElementOf=@9002,
JointType="soldered_connection" );
  @9221:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@122 );
# connector 2/ 1
  @9222:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@722 );
# 088-1CX1/core / end b
@9230:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@113 );
# connector 1/ C/S
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@723 );
# 088-1CX1/shield / end a
@9240:AssemblyShapeJoint( ElementOf=@9002,
JointType="crimped_connection" );
  @9241:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@123 );
# connector 2/ C/S
  @9242:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@724 );
# 088-1CX1/shield / end b

);
```

4.8 EWH-Connectivity4

This test case is similar to the previous connectivity test cases. On the left side we have a connector of type PT06A-10-6S with 6 non-removable contact, while on the right side we have a connector with 6 cavities into which either connector-contacts or if not used sealing plugs are to be inserted. Between the two connectors there is a single wire and a shielded cable with two cores. On the left side the shield of the cable is connected to connector terminal “C” by a shield sleeve of type M83519/2-8. A special “Banding and Shrink Boot Adapter” of type 440DS031NF1002-3 is screwed onto the back-shell of the adapter to guide the wire, cable and shield sleeve. On the right side the shield of the cable is directly connected to the electrified back-shell of the connector (indicated as “B/S”).

Both connectors are delivered as a connector set that have to be assembled while manufacturing the harness. The PT06A-10-6S connector is delivered as three piece parts, the connector_housing, the connector_insert with integrated soldering pins, and the backshell. The MS27484T8F35SB is delivered in likely 8 parts,

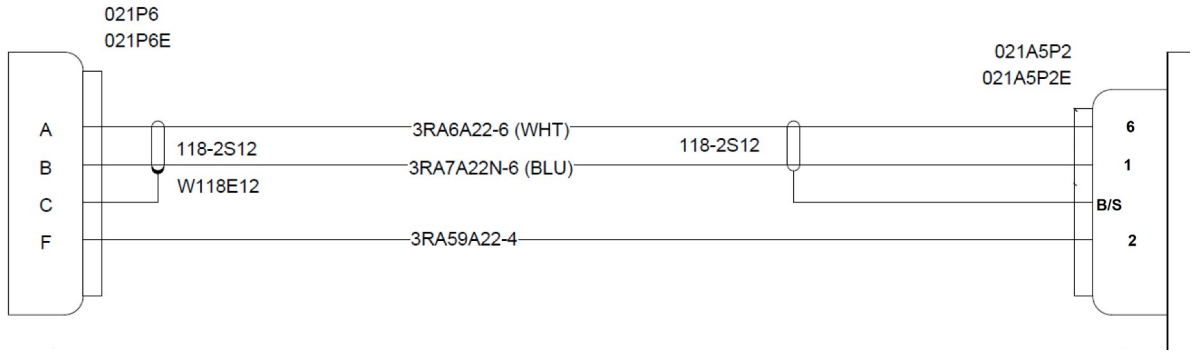

Figure 11: EWH-Connectivity4 - Wiring diagram

Name	Part Number	Nomenclature	Vendor	Test Case
W118E12	M83519/2-8	Shield Sleeve		@100
021P6	PT06A-10-6S	connector	Amphenol	@200
021P6E	440DS031NF1002-3	backshell	Glenair	@300
021A5P2	MS27484T8F35SB	RFI grounding plug	Conesys	@400
021A5P2E	PART OF 021A5P2	Backshell	- dito -	@500
118-2S12	04049A22A02J24	Two Conductor Shielded Cable		@600
3RA59A22-4	04034-22-9	Wire		@700
???	680-116-22	Dummy Contact Sealing Plug	Glenair	@800

Figure 12: EWH-Connectitvity4 - Part List

Figure 13: M83519/2-8: Solder Sleeves & Shield Tubing

Figure 14: Connector: PT06A-10-6S with 6 solder contacts of size 20

Breakdown of MS27484T8F35SB

- MS: Mil. Prefix
- 27484: RFI grounding plug
- T: With accessory thread
- 8: Shell Size = 8
- F: Finish = Aluminum shell, electroless nickel finish
- 35: Insert Arrangement
- S: S=Socket
- B: Polarization / Keying = B

Sednal Technologies Twistrip Cable Die Cross Reference Sheet Updated: 2014-03-31

Manufacturer Cable Part Number	Twistrip Cable Die Part Number	Number of Conductors	Conductor Gauge	Cable Jacket Major OD	Cable Jacket Minor OD	Cable IPR (Pitch)	Cable Jacket Thickness	Shield Thickness	Conductor OD
04049A20A02J24	TDA-2-5836/5R-4	2	20	0.115	0.072	0.99	0.008	0.004	0.050

Figure 15: Two Conductor Shielded Cable 04049A22A02J24

Formal test-case specification:

```
Test EWH-Connectivity4 (

@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@50:Organization( name="TE Connectivity / Raychem")
@51:Organization( name="Amphenol")
@52:Organization( name="Glenair")

@70:WireColourBasedIdentificationCode( Id="white" );
@71:WireColourBasedIdentificationCode( Id="blue" );
@72:WireColourBasedIdentificationCode( Id="shield" );

# Shield Sleeve
@100:Part( Name="Shield Sleeve",
  Description="Solder Sleeves & Shield Tubing S-SLEEVE SHLD TRMNTR 22 AWG"
  PartTypes[i]=PartCategoryEnum(shield_connector),
  PartTypes[i]=PartCategoryEnum(discrete) );
@101:PartVersion;
@102:PartView;
@103:Identifier( Id=IdentifierString("M83519/2-8"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@100, @103, @101, @102, @4);
@104:PartTerminal( ElementOf=@102, Id="Shield-Terminal", DomainType="elec-
trical",
  InterfaceOrJoinTerminal="join_terminal" );
@105:PartTerminal( ElementOf=@102, Id="Wire-Terminal", DomainType="electri-
cal",
  InterfaceOrJoinTerminal="join_terminal" );
@111:SingleOccurrence( Id=IdentifierString("W118E12"), Definition=@102 );
  @112:OccurrenceTerminal( ElementOf=@111, Definition=@104 );
  @113:OccurrenceTerminal( ElementOf=@111, Definition=@105 );

# connector
@200:Part( name="Miniature Cylindrical Connectors"
  Description="Bayonet Coupling with Solder Contact Termination"
  PartTypes[i]=PartCategoryEnum(connector),
  PartTypes[i]=PartCategoryEnum(discrete) );
@201:PartVersion;
@202:PartView;
@203:Identifier( Id=IdentifierString("PT06A-10-6S"),
IdentificationContext=@51 )
Part_with_ID_and_PartView(@200, @203, @201, @202, @4);
@204:PartTerminal( ElementOf=@202, Id="A", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@205:PartTerminal( ElementOf=@202, Id="B", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@206:PartTerminal( ElementOf=@202, Id="C", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@207:PartTerminal( ElementOf=@202, Id="D", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
```

```
@208:PartTerminal( ElementOf=@202, Id="E", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@209:PartTerminal( ElementOf=@202, Id="F", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@210:PartFeature( ElementOf=@202, Id="Thread", DomainType="mechanical" );
@211:SingleOccurrence( Id=IdentifierString("021P6"), Definition=@202 );
  @214:OccurrenceTerminal( ElementOf=@211, Definition=@204 );
  @215:OccurrenceTerminal( ElementOf=@211, Definition=@205 );
  @216:OccurrenceTerminal( ElementOf=@211, Definition=@206 );
  @217:OccurrenceTerminal( ElementOf=@211, Definition=@207 );
  @218:OccurrenceTerminal( ElementOf=@211, Definition=@208 );
  @219:OccurrenceTerminal( ElementOf=@211, Definition=@209 );
  @220:OccurrenceTerminal( ElementOf=@211, Definition=@210 );

# backshell
@300:Part(
   PartTypes[i]=PartCategoryEnum(backshell),
   PartTypes[i]=PartCategoryEnum(discrete) );
@301:PartVersion;
@302:PartView;
@303:Identifier( Id=IdentifierString("440DS031NF1002-3"), Identification-
Context=@52 )
Part_with_ID_and_PartView(@300, @303, @301, @302, @4);
@307:PartContactFeature( ElementOf=@302, Id="Thread");
@308:PartFeature( ElementOf=@302, Id="Segment-Opening");
@311:SingleOccurrence( Id=IdentifierString("021P6E"), Definition=@302 );
  @317:OccurrenceContactFeature( ElementOf=@311, Definition=@307 );
  @318:OccurrenceShapeFeature( ElementOf=@311, Definition=@308 );

# connector
@400:Part( PartTypes[i]=PartCategoryEnum(connector), PartTypes[i]=PartCate-
goryEnum(discrete) );
@401:PartVersion;
@402:PartView;
@403:Identifier( Id=IdentifierString("MS27484T8F35SB"), IdentificationCon-
text=@51 )
Part_with_ID_and_PartView(@400, @403, @401, @402, @4);
@404:PartTerminal( ElementOf=@402, Id="1", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@405:PartTerminal( ElementOf=@402, Id="2", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@406:PartTerminal( ElementOf=@402, Id="3", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@407:PartTerminal( ElementOf=@402, Id="4", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@408:PartTerminal( ElementOf=@402, Id="5", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@409:PartTerminal( ElementOf=@402, Id="6", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@410:PartFeature( ElementOf=@402, Id="Tread"); # contact feature
@411:SingleOccurrence( Id=IdentifierString("021A5P2"), Definition=@402 );
  @414:OccurrenceTerminal( ElementOf=@411, Definition=@404 );
  @415:OccurrenceTerminal( ElementOf=@411, Definition=@405 );
```

```
  @416:OccurrenceTerminal( ElementOf=@411, Definition=@406 );
  @417:OccurrenceTerminal( ElementOf=@411, Definition=@407 );
  @418:OccurrenceTerminal( ElementOf=@411, Definition=@408 );
  @419:OccurrenceTerminal( ElementOf=@411, Definition=@409 );
  @420:OccurrenceTerminal( ElementOf=@411, Definition=@410 );

# electrified backshell
@500:Part(
   PartTypes[i]=PartCategoryEnum(electrified_backshell),
   PartTypes[i]=PartCategoryEnum(discrete) );
@501:PartVersion;
@502:PartView;
@503:Identifier( Id=IdentifierString("PART OF 021A5P2"), IdentificationCon-
text=@51 )
Part_with_ID_and_PartView(@500, @503, @501, @502, @4);
@506:PartTerminal( ElementOf=@502, Id="BS", DomainType="electrical",
  InterfaceOrJoinTerminal="join_terminal" );
@507:PartContactFeature( ElementOf=@502, Id="Thread");
@508:PartFeature( ElementOf=@502, Id="Segment-Opening");
@511:SingleOccurrence( Id=IdentifierString("021A5P2E"), Definition=@502 );
   @516:OccurrenceTerminal( ElementOf=@511, Definition=@506 );
   @517:OccurrenceContactFeature( ElementOf=@511, Definition=@507 );
   @518:OccurrenceShapeFeature( ElementOf=@511, Definition=@508 );

# Cable
@600:Part( PartTypes[i]=PartCategoryEnum(cable), PartTypes[i]=PartCatego-
ryEnum(raw_material_by_length) );
@601:PartVersion;
@602:PartView;
@603:Identifier( Id=IdentifierString("04049A22A02J24"), IdentificationCon-
text=@52 )
Part_with_ID_and_PartView(@600, @603, @601, @602, @4);
@604:WirePartIdentification( ElementOf=@603, Id="white", code=@70 );
@605:WirePartIdentification( ElementOf=@603, Id="blue", code=@71 );
@606:WirePartIdentification( ElementOf=@603, Id="shield", code=@72 );
@611:CableOccurrence( Id=IdentifierString("118-2S12"), Definition=@602,
Quantity=@612 );
   @612:NumericalValue( Unit=@8, ValueComponent=1.8 );
   @613:WireOccurrenceIdentification( ElementOf=@611, Id="3RA6A22-6 (WHT)",
Definition=@604 );
   @614:WireOccurrenceIdentification( ElementOf=@611, Id="3RA7A22N-6 (BLU)",
Definition=@605 );
   @615:WireOccurrenceIdentification( ElementOf=@611, Id="118-2S12", Defini-
tion=@606 );
   @615:CableOccurrenceTerminalLocationGroup( ElementOf=@611, Name="end
a" );
      @621:CableOccurrenceTerminal( ElementOf=@615, AssociatedTransportFea-
ture=@613);
      @622:CableOccurrenceTerminal( ElementOf=@615, AssociatedTransportFea-
ture=@614);
      @623:CableOccurrenceTerminal( ElementOf=@615, AssociatedTransportFea-
ture=@615);
   @616:CableOccurrenceTerminalLocationGroup( ElementOf=@611, Name="end
b" );
```

```
    @624:CableOccurrenceTerminal( ElementOf=@616, AssociatedTransportFea-
ture=@613);
    @625:CableOccurrenceTerminal( ElementOf=@616, AssociatedTransportFea-
ture=@614);
    @626:CableOccurrenceTerminal( ElementOf=@616, AssociatedTransportFea-
ture=@615);

# Wire
@700:Part( PartTypes[i]=PartCategoryEnum(wire),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@701:PartVersion;
@702:PartView;
@703:Identifier( Id=IdentifierString("04034-22-9"),
IdentificationContext=@52 )
Part_with_ID_and_PartView(@700, @703, @701, @702, @4);
@711:WireOccurrence( Id=IdentifierString("3RA59A22-4"), Definition=@602,
Quantity=@712 );
  @712:NumericalValue( Unit=@8, ValueComponent=3.5 );
  @713:WireOccurrenceIdentification( ElementOf=@611, DomainType="electri-
cal" ... )
  @714:WireOccurrenceTerminal( ElementOf=@711,
AssociatedTransportFeature=@713,
  Name="end a" );
  @715:WireOccurrenceTerminal( ElementOf=@711,
AssociatedTransportFeature=@713,
  Name="end b" );

# EWH-Assembly
@9000:Part;
@9001:PartVersion;
@9002:WiringHarnessAssemblyDesign;
@9003:ViewContext;
Part_WiringHarnessAssemblyDesign( @9000,
  "EWH Test-Case Connectivity4",@9001,@9002,@9003 );

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@111 ); # left/
shield_connector
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@211 ); # left
connector
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@311 ); # left
backshell
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@411 ); # right
connector
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@511 ); # right
electrified_backshell
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@611 ); # cable
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@711 ); # wire

# connections
@9210:AssemblyShapeJoint( ElementOf=@9002 );
  @9211:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@621 );
# left white/end a
  @9212:AssemblyShapeJointItemRelationship( Relating=@9210, Related=@214 );
# left connector/A
@9220:AssemblyShapeJoint( ElementOf=@9002 );
```

```
  @9221:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@622 );
# left blue/end a
  @9222:AssemblyShapeJointItemRelationship( Relating=@9220, Related=@215 );
# left connector/B
@9230:AssemblyShapeJoint( ElementOf=@9002 );
  @9231:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@623 );
# left shield/end a
  @9232:AssemblyShapeJointItemRelationship( Relating=@9230, Related=@112 );
# shield_connector
@9240:AssemblyShapeJoint( ElementOf=@9002 );
  @9241:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@113 );
# shield_connector
  @9242:AssemblyShapeJointItemRelationship( Relating=@9240, Related=@216 );
# left connector/C
@9250:AssemblyShapeJoint( ElementOf=@9002 );
  @9251:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@714 );
# wire/end a
  @9252:AssemblyShapeJointItemRelationship( Relating=@9250, Related=@219 );
# left connector/F
@9260:AssemblyShapeJoint( ElementOf=@9002 );
  @9251:AssemblyShapeJointItemRelationship( Relating=@9260, Related=@317 );
# left backshell/Thread
  @9252:AssemblyShapeJointItemRelationship( Relating=@9260, Related=@220 );
# left connector/Thread
@9310:AssemblyShapeJoint( ElementOf=@9002 );
  @9311:AssemblyShapeJointItemRelationship( Relating=@9310, Related=@624 );
# right white/end b
  @9312:AssemblyShapeJointItemRelationship( Relating=@9310, Related=@419 );
# right connector/6
@9320:AssemblyShapeJoint( ElementOf=@9002 );
  @9321:AssemblyShapeJointItemRelationship( Relating=@9320, Related=@625 );
# right blue/end b
  @9322:AssemblyShapeJointItemRelationship( Relating=@9320, Related=@414 );
# right connector/1
@9330:AssemblyShapeJoint( ElementOf=@9002 );
  @9331:AssemblyShapeJointItemRelationship( Relating=@9330, Related=@626 );
# right shield/end b
  @9332:AssemblyShapeJointItemRelationship( Relating=@9330, Related=@516 );
# right electrified_backshell
@9340:AssemblyShapeJoint( ElementOf=@9002 );
  @9341:AssemblyShapeJointItemRelationship( Relating=@9340, Related=@715 );
# wire/end b
  @9342:AssemblyShapeJointItemRelationship( Relating=@9340, Related=@415 );
# right connector/2
@9350:AssemblyShapeJoint( ElementOf=@9002 );
  @9351:AssemblyShapeJointItemRelationship( Relating=@9350, Related=@517 );
# right electrified_backshell/Thread
  @9352:AssemblyShapeJointItemRelationship( Relating=@9350, Related=@420 );
# right connector/Thread

);
```

4.9 EWH-Connectivity5

Purpose of this test case is to introduce a complex modular connector with several inserts and cavities. For this test case a connector according to the European standard EN4644 European standard is chosen; the Radiall's EPX™ connector of type EPXB2

- https://www.radiall.com/products/multipin-aerospace-connectors/rack-and-panel-connectors/epx-trade-en-4644.html

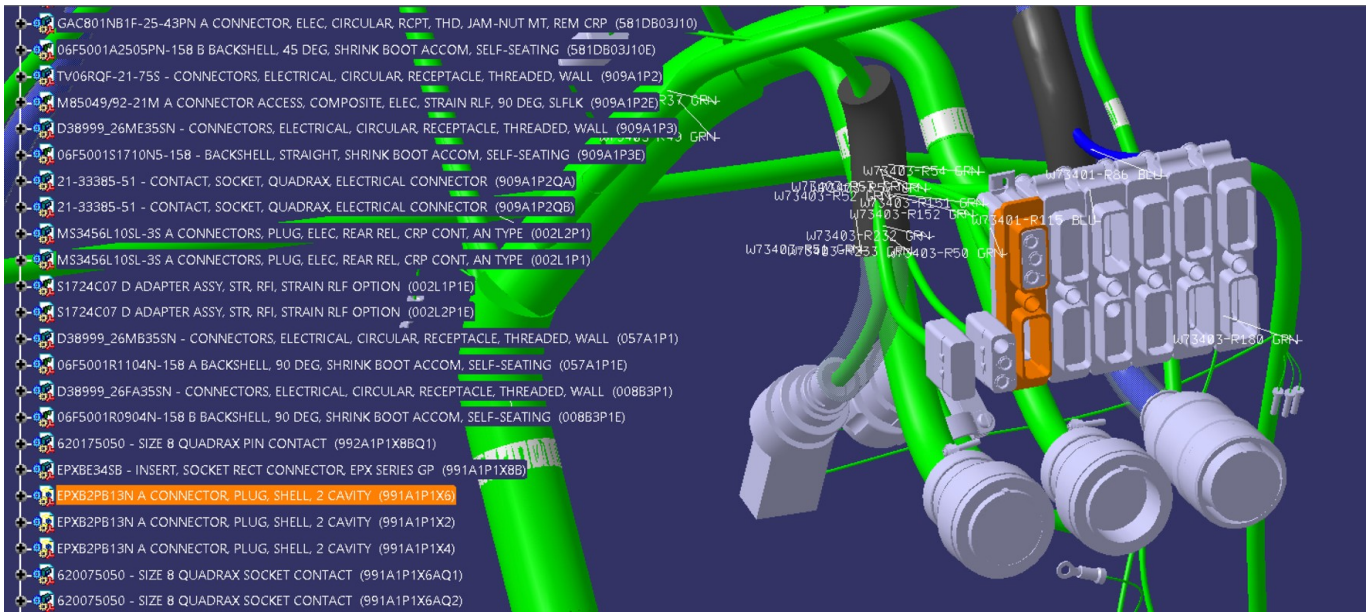

Figure 16: Example of several EWHs that are using EPXB2 connectors

For this particular test case a much smaller example is chosen, consisting of two EPXB2 connectors with the same kind of inserts and connector contacts that are connected with each other in a 1:1 way.

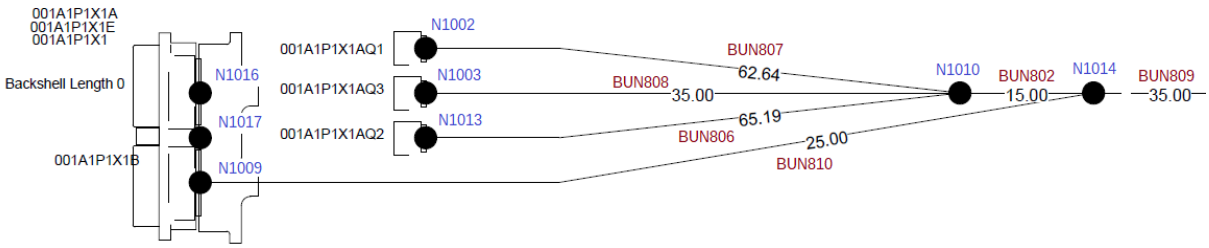

Figure 17: Stick Line Schematics; left side

The right and left side of the stick line schematics is almost symmetric; however there are different lengths and reference designators / IDs.

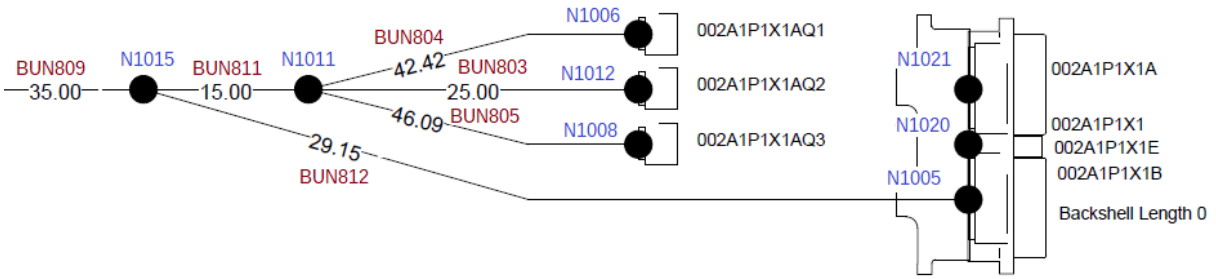

Figure 18: Stick Line Schematics; right side

Each EPXB2 connector consists of two inserts, one with 3 cavities for quadrax connector contacts and one with 28 cavities in two sizes for normal single signal contacts. Each quadrax connector is independently connected by a harness segment that contains a single quadrax cable. The three quadrax cable for one quadrax insert are then combined in a harness node and in another harness node the combined 3 quadrax cables are the combines with a bundle of wires for the other insert.

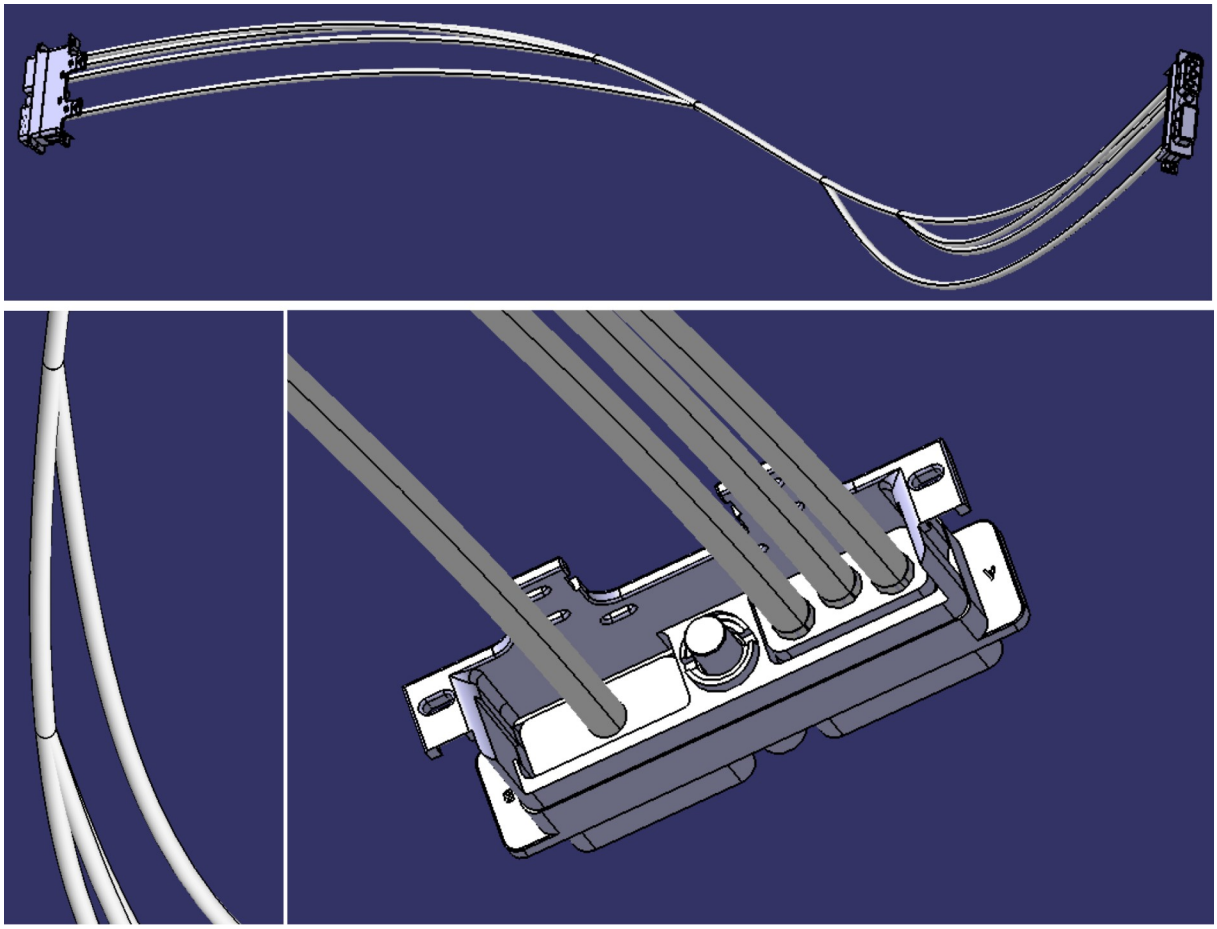

Figure 19: 3D Representation

The wiring diagrams are identical for the left and right side. Here only the diagrams for the left side are shown; one for each insert.

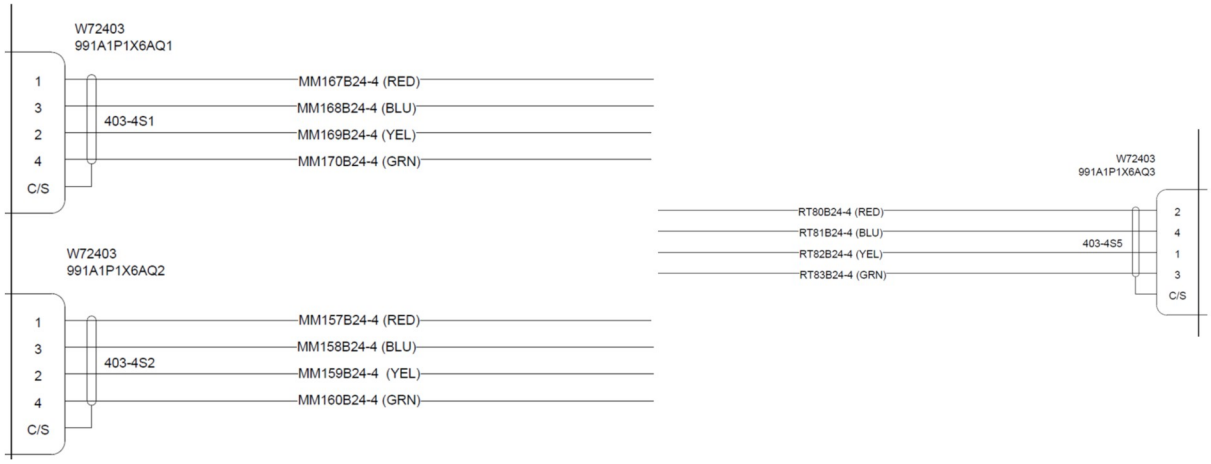

Figure 20: Partial Wiring Diagram for connector / insert X1A

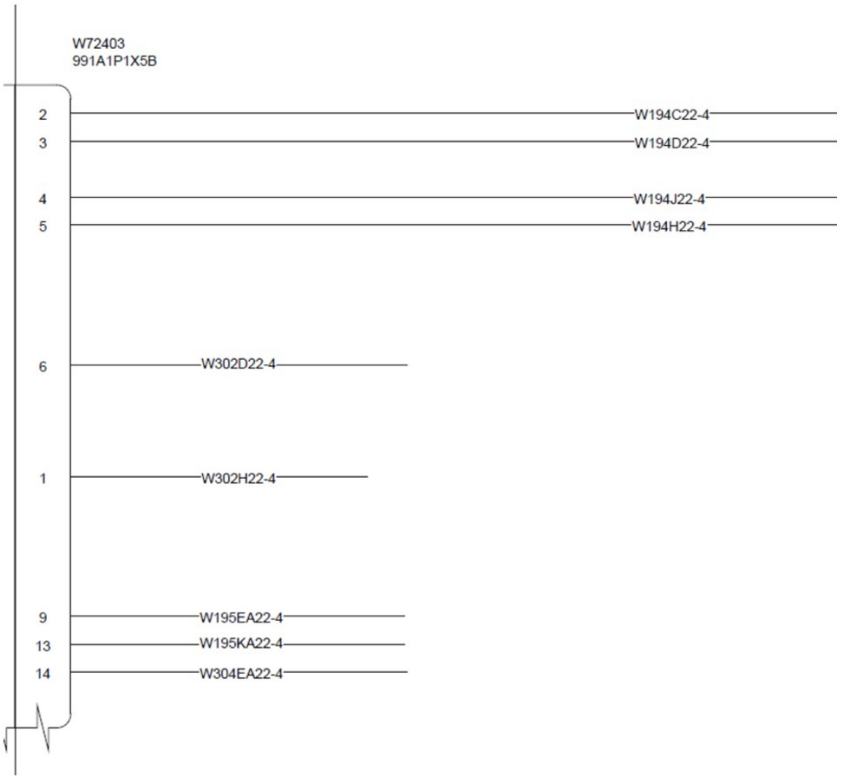

Figure 21: Partial Wiring Diagram for connector / insert X1B

In the EPX part numbers several characteristics of the connector are encoded.

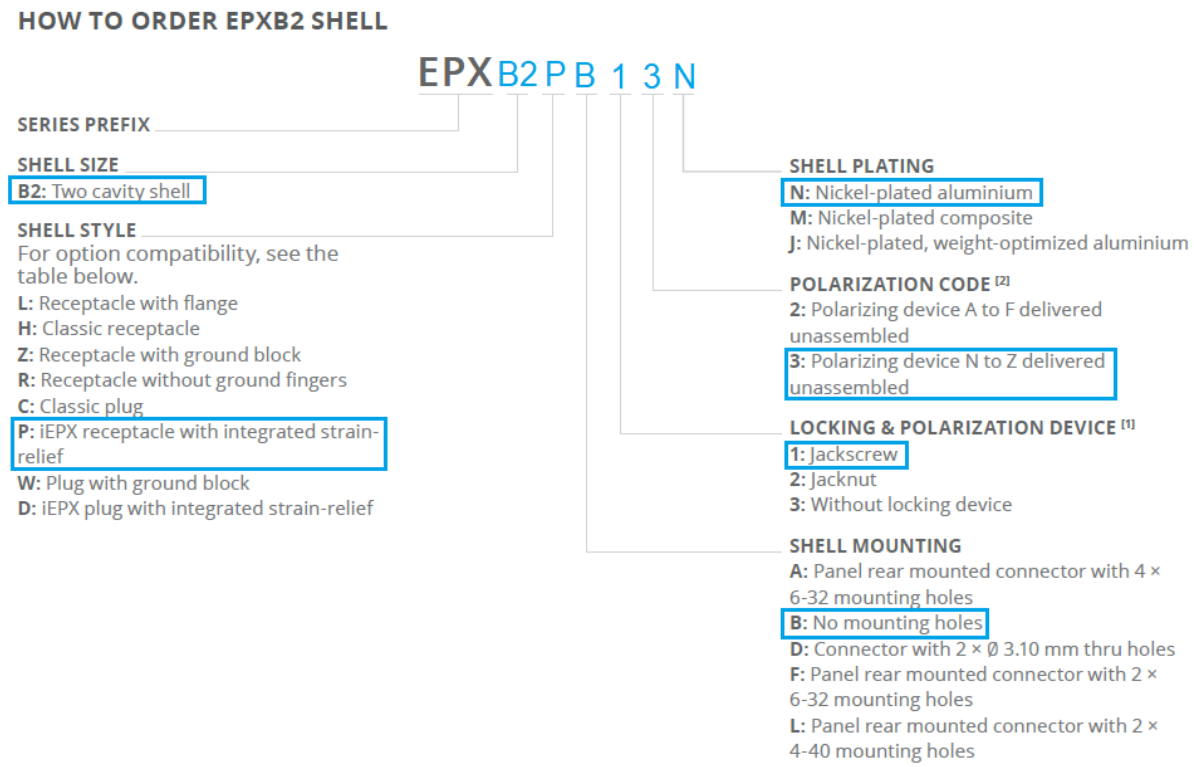

Figure 22: Part Numbers for EPX B2 Shells

Instead of a backshell, strain reliefs are used for the EPX B2 connectors.

	PART NUMBER	DESCRIPTION
	617922007	Straight strain relief (composite)

Figure 23: Strain Relief for EPX B2 connector

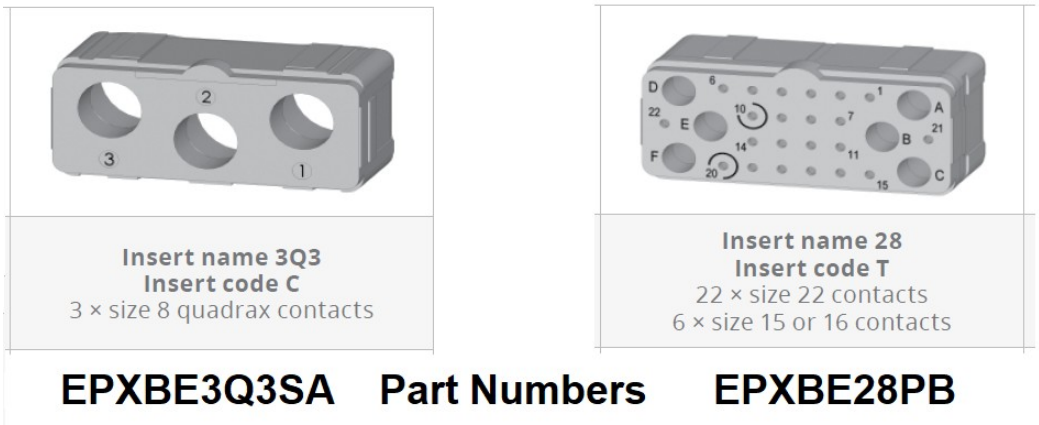

Figure 24: EPX B Inserts

An EPX B2 Shell has two slots for inserts, A and B. For this test case slot A is populated with an insert of type EPXBE3Q3SA that has 3 cavities for quadrax connector contacts, suitable for Ethernet connections. Slot B is populated with an insert of type EPXBE28PB that has 22 cavities of size 22 and 6 cavities of size 15 or 16.

Table 3: Assembly Structure of Size 8 Quadrax Socket Contact 620075050

A quadrax connector/contact is from the modeling point of view a hybrid object. On one hand it is a connector assembly in itself, consisting of a housing, a spacer, an insulator, a ferrule and four connector contacts. But when used inside an EPX insert, the whole quadrax is just a connector contact. For the purpose of this test case we treat the quadrax just as a connector contact with 4 pin terminals and a shield. It is up to the implementors to optionally present the quadrax as a sub-assembly where the terminals of the inner components are “reflected” to the assembly view, similar as it is done for test case EWH_Connectivity3 for the BNC connector. Further information about the quadrax connector/contact is available here:

- Datasheet of 620075050
  https://www.mouser.com/datasheet/2/516/620075050EN-1115692.pdf
- How to wire an quadrax connector
  https://www.radiall.com/media/blfa_files/cabling/ai/rp57339en.pdf
- The tool used to insert Ferrules
  https://www.micro-semiconductor.hu/datasheet/aa-1976593-2.pdf
  Notice the references to Boeing standards in this document
- An overview of “High-Speed Datalink Connectors and Cables for Ethernet-Grade Protocols”
  https://cdn.glenair.com/presentations/pdf/high-speed-datalink-connectors-and-cables-for-ethernet-grade-protocols.pdf

are connected by quadrax cables that consists of 4 core wires and a shield.

All connector parts are from the EPX series from Radiall.

RefDes	Part Type	Part Number	Name	Vendor
001A1P1X1	connector_housing	EPXB2PB13N	EPXB, CONNECTOR SHELL	Radiall
001A1P1XE	strain_relief_accessory	617922007	EPXB, STRAIN RELIEF	-- dito --
001A1P1X1A	connector_insert	EPXBE3Q3SA	EPXB, 3-8 GA	-- dito --
001A1P1X1B	connector_insert	EPXBE28PB	EPXB, 22-22,6-16	-- dito --
001A1P1X1AQ1	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
001A1P1X1AQ2	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
001A1P1X1AQ3	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
002A1P1X1	connector_housing	EPXB2PB13N	EPXB, CONNECTOR SHELL	-- dito --
002A1P1XE	strain_relief_accessory	61792207	EPXB, STRAIN RELIEF	-- dito --
002A1P1X1A	connector_insert	EPXBE3Q3SA	EPXB, 3-8 GA	-- dito --
002A1P1X1B	connector_insert	EPXBE28PB	EPXB, 22-22,6-16	-- dito --
002A1P1X1AQ1	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
002A1P1X1AQ2	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
002A1P1X1AQ3	connector_contact	620075050	QUADRAX CONTACT, SOCKET, 8-GA	-- dito --
-- no -- (18 pieces)	connector_contact	617200	Pin crimp contacts/size 22	-- dito --

Table 4: Connector part List

Cable-RefDes	Wire-RefDes	Type	Part Number	Length	Start Join	End Join	Path
403-4S1		cable	GAC861AH424S	4.573524			
-- dito --	403-4S1	wire	-- dito --	4.573524	TERM104	TERM128	(BUN807, BUN802, BUN809, BUN811, BUN804)
-- dito --	MMB167B24-4 (RED)	wire	-- dito --	4.573524	TERM100	TERM124	-- dito --
-- dito --	MMB168B24-4 (BLU)	wire	-- dito --	4.573524	TERM102	TERM126	-- dito --
-- dito --	MMB169B24-4 (YEL)	wire	-- dito --	4.573524	TERM101	TERM125	-- dito --
-- dito --	MMB170B24-4 (GRN)	wire	-- dito --	4.573524	TERM103	TERM127	-- dito --
403-4S2		cable	GAC861AH424S	4.195826			
-- dito --	SHIELD39502	wire	-- dito --	4.195826	TERM109	TERM133	(BUN808, , BUN802, BUN809, BUN811, BUN803)
-- dito --	MMB158B24-4 (RED)	wire	-- dito --	4.195826	TERM107	TERM131	-- dito --
-- dito --	MMB157B24-4 (RED)	wire	-- dito --	4.195826	TERM105	TERM129	-- dito --
-- dito --	MMB159B24-4 (RED)	wire	-- dito --	4.195826	TERM106	TERM130	-- dito --
-- dito --	MMB160B24-4 (RED)	wire	-- dito --	4.195826	TERM108	TERM132	-- dito --
403-4S5		cable	GAC861AH424S	3.964686			
-- dito --	SHIELD39504	wire	-- dito --	3.964686	TERM114	TERM138	(BUN806, BUN802, BUN809, BUN811, BUN805)
-- dito --	RT81B24-4 (BLU)	wire	-- dito --	3.964686	TERM112	TERM136	-- dito --
-- dito --	RT80B24-4 (RED)	wire	-- dito --	3.964686	TERM110	TERM134	-- dito --
-- dito --	RT82B24-4 (YEL)	wire	-- dito --	3.964686	TERM111	TERM135	-- dito --
-- dito --	RT83B24-4 (GRN)	wire	-- dito --	3.964686	TERM113	TERM137	-- dito --
-- no --	W194C22-4	wire	04034-22-9	2.490851	TERM116	TERM140	(BUN810, BUN811, BUN812)
-- no --	W194D22-4	wire	04034-22-9	2.490851	TERM117	TERM141	-- dito --
-- no --	W194J22-4	wire	04034-22-9	2.490851	TERM118	TERM142	-- dito --
-- no --	W194H22-4	wire	04034-22-9	2.490851	TERM119	TERM143	-- dito --
-- no --	W195EA22-4	wire	04034-22-9	2.490851	TERM121	TERM145	-- dito --
-- no --	W195KA22-4	wire	04034-22-9	2.490851	TERM122	TERM146	-- dito --
-- no --	W302D22-4	wire	04034-22-9	2.490851	TERM120	TERM144	-- dito --
-- no --	W302H22-4	wire	04034-22-9	2.490851	TERM115	TERM139	-- dito --
-- no --	W304EA22-4	wire	04034-22-9	2.490851	TERM123	TERM147	-- dito --

GAC861AH424S	e.g. from Thermax, https://www.thermaxglobal.com/
04034-22-9	from Carlisle Interconnect Technologies

Table 5: Wire List

RefDes1	RefDes2	RefDes3	PartNumber	Feature	Join
001A1P1X1			EPXB2PB13N		
-- dito --	001A1P1X1A		EPXBE3Q3SA		
-- dito --	-- dito --	001A1P1X1AQ1	620075050		
-- dito --	-- dito --	-- dito --	-- dito --	1	TERM100
-- dito --	-- dito --	-- dito --	-- dito --	2	TERM101
-- dito --	-- dito --	-- dito --	-- dito --	3	TERM102
-- dito --	-- dito --	-- dito --	-- dito --	4	TERM103
-- dito --	-- dito --	-- dito --	-- dito --	SC	TERM104
-- dito --	-- dito --	001A1P1X1AQ1	620075050		
-- dito --	-- dito --	-- dito --	-- dito --	1	TERM105
-- dito --	-- dito --	-- dito --	-- dito --	2	TERM106
-- dito --	-- dito --	-- dito --	-- dito --	3	TERM107
-- dito --	-- dito --	-- dito --	-- dito --	4	TERM108
-- dito --	-- dito --	-- dito --	-- dito --	SC	TERM109
-- dito --	-- dito --	001A1P1X1AQ1	620075050		
-- dito --	-- dito --	-- dito --	-- dito --	1	TERM110
-- dito --	-- dito --	-- dito --	-- dito --	2	TERM111
-- dito --	-- dito --	-- dito --	-- dito --	3	TERM112
-- dito --	-- dito --	-- dito --	-- dito --	4	TERM113
-- dito --	-- dito --	-- dito --	-- dito --	SC	TERM114
-- dito --	001A1P1X1B		EPXBE28PB		
-- dito --	-- dito --	-- np -- / 617200	-- dito --	1	TERM115
-- dito --	-- dito --	-- np -- / 617200	-- dito --	2	TERM116
-- dito --	-- dito --	-- np -- / 617200	-- dito --	3	TERM117
-- dito --	-- dito --	-- np -- / 617200	-- dito --	4	TERM118
-- dito --	-- dito --	-- np -- / 617200	-- dito --	5	TERM119
-- dito --	-- dito --	-- np -- / 617200	-- dito --	6	TERM120
-- dito --	-- dito --		-- dito --	7	-- nc --
-- dito --	-- dito --		-- dito --	8	-- nc --
-- dito --	-- dito --	-- np -- / 617200	-- dito --	9	TERM121
-- dito --	-- dito --		-- dito --	10	-- nc --
-- dito --	-- dito --		-- dito --	11	-- nc --
-- dito --	-- dito --		-- dito --	12	-- nc --
-- dito --	-- dito --	-- np -- / 617200	-- dito --	13	TERM122
-- dito --	-- dito --	-- np -- / 617200	-- dito --	14	TERM123
-- dito --	-- dito --		-- dito --	15	-- nc --
-- dito --	-- dito --		-- dito --	16	-- nc --
-- dito --	-- dito --		-- dito --	17	-- nc --
-- dito --	-- dito --		-- dito --	18	-- nc --
-- dito --	-- dito --		-- dito --	19	-- nc --
-- dito --	-- dito --		-- dito --	20	-- nc --
-- dito --	-- dito --		-- dito --	21	-- nc --
-- dito --	-- dito --		-- dito --	22	-- nc --
-- dito --	-- dito --		-- dito --	A	-- nc --
-- dito --	-- dito --		-- dito --	B	-- nc --
-- dito --	-- dito --		-- dito --	C	-- nc --
-- dito --	-- dito --		-- dito --	D	-- nc --
-- dito --	-- dito --		-- dito --	E	-- nc --
-- dito --	-- dito --		-- dito --	F	-- nc --

"-- dito --"	same as above
"-- nc --"	"not connected"
"-- np --"	"not provided"

Table 6: Connection list at connector X1

Bundle	Start Node	End Node	Length
BUN802	N1010	N1014	0.381
BUN803	N1011	N1012	0.635
BUN804	N1011	N1006	1.077468
BUN805	N1011	N1008	1.170686
BUN806	N1010	N1013	0.889
BUN807	N1010	N1002	1.591056
BUN808	N1010	N1003	1.655826
BUN809	N1014	N1015	0.889
BUN810	N1014	N1009	0.635
BUN811	N1011	N1015	0.381
BUN812	N1005	N1015	0.74041

Table 7: Edges of the Topological Model

Node	Connector RefDes	Bundels	HarnessNode Type
N1002	001A1P1X1AQ1	(BUN807)	extremity_node
N1003	001A1P1X1AQ2	(BUN808)	extremity_node
N1005	002A1P1X1B	(BUN812)	extremity_node
N1006	002A1P1X1AQ1	(BUN804)	extremity_node
N1008	002A1P1X1AQ3	(BUN805)	extremity_node
N1009	001A1P1X1B	(BUN810)	extremity_node
N1010	--	(BUN802, BUN806, BUN807, BUN808)	branch_node
N1011	--	(BUN803, BUN804, BUN805, BUN811)	branch_node
N1012	002A1P1X1AQ2	(BUN803)	extremity_node
N1013	001A1P1X1AQ3	(BUN806)	extremity_node
N1014	--	(BUN802, BUN809, BUN810)	branch_node
N1015	--	(BUN809, BUN811, BUN812)	branch_node
N1016	001A1P1X1A	( ) -- not used	(extremity_node)
N1017	001A1P1X1 / backshell	( ) -- not used	(extremity_node)
N1020	002A1P1X1 / backshell	( ) -- not used	(extremity_node)
N1021	002A1P1X1A	( ) -- not used	(extremity_node)

Table 8: Vertices of the Topological Model resp. HarnessNodes

This test case comes together with a corresponding KBL and Capital Harness / Siemens XML file. It is up to implementors to either import these files into their source system or to create the harness anew in their source system.

Formal test-case specification:

```
Test EWH-Connectivity5 (

@4:ViewContext;
@5:ViewContext;
@8:Unit( Name=ClassString("metre"), Quantity=ClassString("length") );

@50:Organization( name="Radiall")
@51:Organization( name="Thermax")
@52:Organization( name="Carlisle Interconnect Technologies")

@70:WireColourBasedIdentificationCode( Id="shield" );
@71:WireColourBasedIdentificationCode( Id="red" );
@72:WireColourBasedIdentificationCode( Id="blue" );
@73:WireColourBasedIdentificationCode( Id="yellow" );
@74:WireColourBasedIdentificationCode( Id="green" );

# EPX size 8 cavities and contact profiles
@1000:ContactFeatureDefinitionFitRelationship( Name="EPX cavity-plug-con-
tact 8 fit",
  Relating=@1001, Related=@1002 );
@1001:ContactFeatureDefinition( Name="EPX size 8 cavity",
  ShapeFeatureType=cavity_profile );
@1002:ContactFeatureDefinition( Name="EPX size 8 plug/contact",
  ShapeFeatureType=cavity_plug_or_contact_profile );

# EPX size 22 cavities and contact profiles
@1010:ContactFeatureDefinitionFitRelationship( Name="EPX size 22 fit",
  Relating=@1011, Related=@1012 );
@1011:ContactFeatureDefinition( Name="EPX size 22 cavity",
  ShapeFeatureType=cavity_profile );
@1012:ContactFeatureDefinition( Name="EPX size 22 plug/contact",
  ShapeFeatureType=cavity_plug_or_contact_profile );

# EPXB slot and insert profiles
@1020:ContactFeatureDefinitionFitRelationship( Name="EPXB slot-insert fit",
  Relating=@1021, Related=@1022 );
@1021:ContactFeatureDefinition( Name="EPXB slot profile",
  ShapeFeatureType=slot_profile );
@1022:ContactFeatureDefinition( Name="EPXB insert profile",
  ShapeFeatureType=insert_profile );

# EPXB2 housing and backshell profiles
@1030:ContactFeatureDefinitionFitRelationship( Name="EPXB2 housing-back-
shell fit",
  Relating=@1031, Related=@1032 );
@1031:ContactFeatureDefinition( Name="EPXB2 housing profile" );
@1032:ContactFeatureDefinition( Name="EPXB2 backshell profile" );

# EPX size 15/16 cavities and size 15 and 16 contact profiles
@1040:ContactFeatureDefinitionFitRelationship( Name="EPX size 15-15 fit",
  Relating=@1042, Related=@1043 );
@1041:ContactFeatureDefinitionFitRelationship( Name="EPX size 15-16 fit",
```

```
  Relating=@1042, Related=@1044 );
@1042:ContactFeatureDefinition( Name="EPX size 15/16 cavity",
  ShapeFeatureType=cavity_profile );
@1043:ContactFeatureDefinition( Name="EPX size 15 plug/contact",
  ShapeFeatureType=cavity_plug_or_contact_profile );
@1044:ContactFeatureDefinition( Name="EPX size 16 plug/contact",
  ShapeFeatureType=cavity_plug_or_contact_profile );

# connector_housing
@1100:Part( Name="EPXB, CONNECTOR SHELL",
  PartTypes[i]=PartCategoryEnum(connector_housing),
  PartTypes[i]=PartCategoryEnum(discrete) );
@1101:PartVersion;
@1103:Identifier( Id=IdentifierString("EPXB2PB13N"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1100, @1103, @1101, @1102, @4);
@1102:PartView;
  @1111:PartContactFeature( ElementOf=@1102, Id="A",
PartDefinition=@1021 );
  @1112:PartContactFeature( ElementOf=@1102, Id="B",
PartDefinition=@1021 );
  @1113:PartContactFeature( ElementOf=@1102, PartDefinition=@1031 );
@11010:SingleOccurrence( Id=IdentifierString("001A1P1X1"), Definition=@1102
);
  #11011:OccurrenceContactFeature( ElementOf=@11010, Definition=@1111 );
  #11012:OccurrenceContactFeature( ElementOf=@11010, Definition=@1112 );
  #11013:OccurrenceContactFeature( ElementOf=@11010, Definition=@1113 );
@11020:SingleOccurrence( Id=IdentifierString("002A1P1X1"), Definition=@1102
);
  #11021:OccurrenceContactFeature( ElementOf=@11020, Definition=@1111 );
  #11022:OccurrenceContactFeature( ElementOf=@11020, Definition=@1112 );
  #11023:OccurrenceContactFeature( ElementOf=@11020, Definition=@1113 );

# strain_relief_accessory
@1200:Part( Name="EPXB, STRAIN RELIEF",
  PartTypes[i]=PartCategoryEnum(strain_relief_accessory),
  PartTypes[i]=PartCategoryEnum(discrete) );
@1201:PartVersion;
@1203:Identifier( Id=IdentifierString("EPXB2PB13N"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1200, @1203, @1201, @1202, @4);
@1202:PartView;
  @12021:PartContactFeature( ElementOf=@1102, Id="B",
PartDefinition=@1032 );
@12010:SingleOccurrence( Id=IdentifierString("001A1P1XE"), Definition=@1102
);
  #120101:OccurrenceContactFeature( ElementOf=@12010, Definition=@12021 );
@12020:SingleOccurrence( Id=IdentifierString("002A1P1XE"), Definition=@1102
);
  #120201:OccurrenceContactFeature( ElementOf=@12020, Definition=@12021 );

# connector_insert EPXBE3Q3SA
@1300:Part( Name="EPXB, 3-8 GA",
  PartTypes[i]=PartCategoryEnum(connector_insert),
```

```
  PartTypes[i]=PartCategoryEnum(discrete) );
@1301:PartVersion;
@1303:Identifier( Id=IdentifierString("EPXBE3Q3SA"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1300, @1303, @1301, @1302, @4);
@1302:PartView;
  @13021:PartShapeFeature( ElementOf=@1302, Id="1", PartDefinition=@1002 );
  @13022:PartShapeFeature( ElementOf=@1302, Id="2", PartDefinition=@1002 );
  @13023:PartShapeFeature( ElementOf=@1302, Id="3", PartDefinition=@1002 );
  @13024:PartShapeFeature( ElementOf=@1302, PartDefinition=@1022 );
@1311:SingleOccurrence( Id=IdentifierString("001A1P1X1A"), Definition=@1302
);
   @13111:OccurrenceContactFeature( ElementOf=@1311, Definition=@13021 );
   @13112:OccurrenceContactFeature( ElementOf=@1311, Definition=@13022 );
   @13113:OccurrenceContactFeature( ElementOf=@1311, Definition=@13023 );
   @13114:OccurrenceContactFeature( ElementOf=@1311, Definition=@13024 );
@1321:SingleOccurrence( Id=IdentifierString("002A1P1X1A"), Definition=@1302
);
   @13211:OccurrenceContactFeature( ElementOf=@1321, Definition=@13021 );
   @13212:OccurrenceContactFeature( ElementOf=@1321, Definition=@13022 );
   @13213:OccurrenceContactFeature( ElementOf=@1321, Definition=@13023 );
   @13214:OccurrenceContactFeature( ElementOf=@1321, Definition=@13024 );

# connector_insert EPXBE28PB
@1400:Part( Name="EPXB, 22-22,6-16",
  PartTypes[i]=PartCategoryEnum(connector_insert),
  PartTypes[i]=PartCategoryEnum(discrete) );
@1401:PartVersion;
@1403:Identifier( Id=IdentifierString("EPXBE28PB"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1400, @1403, @1401, @1402, @4);
@1402:PartView;
  # for the definition (in library) list all cavities/profiles
  @140200:PartShapeFeature( ElementOf=@1402, PartDefinition=@1022 );
  @140201:PartShapeFeature( ElementOf=@1402, Id="1",
PartDefinition=@1011 );
  @140202:PartShapeFeature( ElementOf=@1402, Id="2",
PartDefinition=@1011 );
  @140203:PartShapeFeature( ElementOf=@1402, Id="3",
PartDefinition=@1011 );
  @140204:PartShapeFeature( ElementOf=@1402, Id="4",
PartDefinition=@1011 );
  @140205:PartShapeFeature( ElementOf=@1402, Id="5",
PartDefinition=@1011 );
  @140206:PartShapeFeature( ElementOf=@1402, Id="6",
PartDefinition=@1011 );
  @140207:PartShapeFeature( ElementOf=@1402, Id="7",
PartDefinition=@1011 );
  @140208:PartShapeFeature( ElementOf=@1402, Id="8",
PartDefinition=@1011 );
  @140209:PartShapeFeature( ElementOf=@1402, Id="9",
PartDefinition=@1011 );
  @140210:PartShapeFeature( ElementOf=@1402, Id="10",
PartDefinition=@1011 );
```

```
  @140211:PartShapeFeature( ElementOf=@1402, Id="11",
PartDefinition=@1011 );
  @140212:PartShapeFeature( ElementOf=@1402, Id="12",
PartDefinition=@1011 );
  @140213:PartShapeFeature( ElementOf=@1402, Id="13",
PartDefinition=@1011 );
  @140214:PartShapeFeature( ElementOf=@1402, Id="14",
PartDefinition=@1011 );
  @140215:PartShapeFeature( ElementOf=@1402, Id="15",
PartDefinition=@1011 );
  @140216:PartShapeFeature( ElementOf=@1402, Id="16",
PartDefinition=@1011 );
  @140217:PartShapeFeature( ElementOf=@1402, Id="17",
PartDefinition=@1011 );
  @140218:PartShapeFeature( ElementOf=@1402, Id="18",
PartDefinition=@1011 );
  @140219:PartShapeFeature( ElementOf=@1402, Id="19",
PartDefinition=@1011 );
  @140220:PartShapeFeature( ElementOf=@1402, Id="20",
PartDefinition=@1011 );
  @140221:PartShapeFeature( ElementOf=@1402, Id="21",
PartDefinition=@1011 );
  @140222:PartShapeFeature( ElementOf=@1402, Id="22",
PartDefinition=@1011 );
  @140231:PartShapeFeature( ElementOf=@1402, Id="A",
PartDefinition=@1011 );
  @140232:PartShapeFeature( ElementOf=@1402, Id="B",
PartDefinition=@1011 );
  @140233:PartShapeFeature( ElementOf=@1402, Id="C",
PartDefinition=@1011 );
  @140234:PartShapeFeature( ElementOf=@1402, Id="D",
PartDefinition=@1011 );
  @140235:PartShapeFeature( ElementOf=@1402, Id="E",
PartDefinition=@1011 );
  @140236:PartShapeFeature( ElementOf=@1402, Id="F",
PartDefinition=@1011 );
@1411:SingleOccurrence( Id=IdentifierString("001A1P1X1B"), Definition=@1402
);
  # for the occurrence only used cavities/profiles are listed
   @141100:OccurrenceContactFeature( ElementOf=@1411, Definition=@140200 );
   @141101:OccurrenceContactFeature( ElementOf=@1411, Definition=@140201 );
   @141102:OccurrenceContactFeature( ElementOf=@1411, Definition=@140202 );
   @141103:OccurrenceContactFeature( ElementOf=@1411, Definition=@140203 );
   @141104:OccurrenceContactFeature( ElementOf=@1411, Definition=@140204 );
   @141105:OccurrenceContactFeature( ElementOf=@1411, Definition=@140205 );
   @141106:OccurrenceContactFeature( ElementOf=@1411, Definition=@140206 );
   @141109:OccurrenceContactFeature( ElementOf=@1411, Definition=@140209 );
   @141113:OccurrenceContactFeature( ElementOf=@1411, Definition=@140213 );
   @141114:OccurrenceContactFeature( ElementOf=@1411, Definition=@140214 );
@1421:SingleOccurrence( Id=IdentifierString("002A1P1X1B"), Definition=@1402
);
  # for the occurrence only used cavities/profiles are listed
   @142100:OccurrenceContactFeature( ElementOf=@1421, Definition=@140200 );
   @142101:OccurrenceContactFeature( ElementOf=@1421, Definition=@140201 );
   @142102:OccurrenceContactFeature( ElementOf=@1421, Definition=@140202 );
   @142103:OccurrenceContactFeature( ElementOf=@1421, Definition=@140203 );
```

```
   @142104:OccurrenceContactFeature( ElementOf=@1421, Definition=@140204 );
   @142105:OccurrenceContactFeature( ElementOf=@1421, Definition=@140205 );
   @142106:OccurrenceContactFeature( ElementOf=@1421, Definition=@140206 );
   @142109:OccurrenceContactFeature( ElementOf=@1421, Definition=@140209 );
   @142113:OccurrenceContactFeature( ElementOf=@1421, Definition=@140213 );
   @142114:OccurrenceContactFeature( ElementOf=@1421, Definition=@140214 );

# connector_contact 620075050
@1500:Part( Name="QUADRAX CONTACT, SOCKET, 8-GA",
  PartTypes[i]=PartCategoryEnum(connector_contact),
  PartTypes[i]=PartCategoryEnum(discrete) );
@1501:PartVersion;
@1503:Identifier( Id=IdentifierString("EPXB2PB13N"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1500, @1503, @1501, @1502, @4);
@1502:PartView;
  @1591:PartTerminal( ElementOf=@1502, Id="1", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
  @1592:PartTerminal( ElementOf=@1502, Id="2", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
  @1593:PartTerminal( ElementOf=@1502, Id="3", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
  @1594:PartTerminal( ElementOf=@1502, Id="4", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
  @1595:PartTerminal( ElementOf=@1502, Id="SC", DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
  @1596:PartContactFeature( ElementOf=@1502, PartDefinition=@1002 );
  @1597:PartShapeFeature( ElementOf=@1502, Id="EPX quadrax connector_con-
tact to quadrax cable opening" );
@1510:SingleOccurrence( Id=IdentifierString("001A1P1X1AQ1"),
Definition=@1502 );
  @1511:OccurrenceTerminal( ElementOf=@1510, Definition=@1591 );
  @1512:OccurrenceTerminal( ElementOf=@1510, Definition=@1592 );
  @1513:OccurrenceTerminal( ElementOf=@1510, Definition=@1593 );
  @1514:OccurrenceTerminal( ElementOf=@1510, Definition=@1594 );
  @1515:OccurrenceTerminal( ElementOf=@1510, Definition=@1595 );
  @1516:OccurrenceContactFeature( ElementOf=@1510, Definition=@1596 );
  @1517:OccurrenceShapeFeature( ElementOf=@1510, Definition=@1597 );
@1520:SingleOccurrence( Id=IdentifierString("001A1P1X1AQ2"),
Definition=@1502 );
  @1521:OccurrenceTerminal( ElementOf=@1520, Definition=@1591 );
  @1522:OccurrenceTerminal( ElementOf=@1520, Definition=@1592 );
  @1523:OccurrenceTerminal( ElementOf=@1520, Definition=@1593 );
  @1524:OccurrenceTerminal( ElementOf=@1520, Definition=@1594 );
  @1525:OccurrenceTerminal( ElementOf=@1520, Definition=@1595 );
  @1526:OccurrenceContactFeature( ElementOf=@1520, Definition=@1596 );
  @1527:OccurrenceShapeFeature( ElementOf=@1520, Definition=@1597 );
@1530:SingleOccurrence( Id=IdentifierString("001A1P1X1AQ3"),
Definition=@1502 );
  @1531:OccurrenceTerminal( ElementOf=@1530, Definition=@1591 );
  @1532:OccurrenceTerminal( ElementOf=@1530, Definition=@1592 );
  @1533:OccurrenceTerminal( ElementOf=@1530, Definition=@1593 );
  @1534:OccurrenceTerminal( ElementOf=@1530, Definition=@1594 );
  @1535:OccurrenceTerminal( ElementOf=@1530, Definition=@1595 );
```

```
  @1536:OccurrenceContactFeature( ElementOf=@1530, Definition=@1596 );
  @1537:OccurrenceShapeFeature( ElementOf=@1530, Definition=@1597 );
@1540:SingleOccurrence( Id=IdentifierString("002A1P1X1AQ1"),
Definition=@1502 );
  @1541:OccurrenceTerminal( ElementOf=@1540, Definition=@1591 );
  @1542:OccurrenceTerminal( ElementOf=@1540, Definition=@1592 );
  @1543:OccurrenceTerminal( ElementOf=@1540, Definition=@1593 );
  @1544:OccurrenceTerminal( ElementOf=@1540, Definition=@1594 );
  @1545:OccurrenceTerminal( ElementOf=@1540, Definition=@1595 );
  @1546:OccurrenceContactFeature( ElementOf=@1540, Definition=@1596 );
  @1547:OccurrenceShapeFeature( ElementOf=@1540, Definition=@1597 );
@1550:SingleOccurrence( Id=IdentifierString("002A1P1X1AQ2"),
Definition=@1502 );
  @1551:OccurrenceTerminal( ElementOf=@1550, Definition=@1591 );
  @1552:OccurrenceTerminal( ElementOf=@1550, Definition=@1592 );
  @1553:OccurrenceTerminal( ElementOf=@1550, Definition=@1593 );
  @1554:OccurrenceTerminal( ElementOf=@1550, Definition=@1594 );
  @1555:OccurrenceTerminal( ElementOf=@1550, Definition=@1595 );
  @1556:OccurrenceContactFeature( ElementOf=@1550, Definition=@1596 );
  @1557:OccurrenceShapeFeature( ElementOf=@1550, Definition=@1597 );
@1560:SingleOccurrence( Id=IdentifierString("002A1P1X1AQ3"),
Definition=@1502 );
  @1561:OccurrenceTerminal( ElementOf=@1560, Definition=@1591 );
  @1562:OccurrenceTerminal( ElementOf=@1560, Definition=@1592 );
  @1563:OccurrenceTerminal( ElementOf=@1560, Definition=@1593 );
  @1564:OccurrenceTerminal( ElementOf=@1560, Definition=@1594 );
  @1565:OccurrenceTerminal( ElementOf=@1560, Definition=@1595 );
  @1566:OccurrenceContactFeature( ElementOf=@1560, Definition=@1596 );
  @1567:OccurrenceShapeFeature( ElementOf=@1560, Definition=@1597 );

# connector_contact 617200
@1600:Part( Name="Pin crimp contacts/size 22",
  PartTypes[i]=PartCategoryEnum(connector_contact),
  PartTypes[i]=PartCategoryEnum(discrete) );
@1601:PartVersion;
@1603:Identifier( Id=IdentifierString("617200"),
IdentificationContext=@50 )
Part_with_ID_and_PartView(@1600, @1603, @1601, @1602, @4);
@1602:PartView;
  @1603:PartTerminal( ElementOf=@1502, DomainType="electrical",
    InterfaceOrJoinTerminal="join_terminal" );
@16010:SingleOccurrence( Id=IdentifierString("617200_1"),
Definition=@1602 );
  @16011:OccurrenceTerminal( ElementOf=@16010, Definition=@1603 );
@16020:SingleOccurrence( Id=IdentifierString("617200_2"),
Definition=@1602 );
  @16021:OccurrenceTerminal( ElementOf=@16020, Definition=@1603 );
@16030:SingleOccurrence( Id=IdentifierString("617200_3"),
Definition=@1602 );
  @16031:OccurrenceTerminal( ElementOf=@16030, Definition=@1603 );
@16040:SingleOccurrence( Id=IdentifierString("617200_4"),
Definition=@1602 );
  @16041:OccurrenceTerminal( ElementOf=@16040, Definition=@1603 );
```

```
@16050:SingleOccurrence( Id=IdentifierString("617200_5"),
Definition=@1602 );
  @16051:OccurrenceTerminal( ElementOf=@16050, Definition=@1603 );
@16060:SingleOccurrence( Id=IdentifierString("617200_6"),
Definition=@1602 );
  @16061:OccurrenceTerminal( ElementOf=@16060, Definition=@1603 );
@16070:SingleOccurrence( Id=IdentifierString("617200_7"),
Definition=@1602 );
  @16071:OccurrenceTerminal( ElementOf=@16070, Definition=@1603 );
@16080:SingleOccurrence( Id=IdentifierString("617200_8"),
Definition=@1602 );
  @16081:OccurrenceTerminal( ElementOf=@16080, Definition=@1603 );
@16090:SingleOccurrence( Id=IdentifierString("617200_9"),
Definition=@1602 );
  @16091:OccurrenceTerminal( ElementOf=@16090, Definition=@1603 );
@16110:SingleOccurrence( Id=IdentifierString("617200_11"), Definition=@1602
);
  @16111:OccurrenceTerminal( ElementOf=@16110, Definition=@1603 );
@16120:SingleOccurrence( Id=IdentifierString("617200_12"), Definition=@1602
);
  @16121:OccurrenceTerminal( ElementOf=@16120, Definition=@1603 );
@16130:SingleOccurrence( Id=IdentifierString("617200_13"), Definition=@1602
);
  @16131:OccurrenceTerminal( ElementOf=@16130, Definition=@1603 );
@16140:SingleOccurrence( Id=IdentifierString("617200_14"), Definition=@1602
);
  @16141:OccurrenceTerminal( ElementOf=@16140, Definition=@1603 );
@16150:SingleOccurrence( Id=IdentifierString("617200_15"), Definition=@1602
);
  @16151:OccurrenceTerminal( ElementOf=@16150, Definition=@1603 );
@16160:SingleOccurrence( Id=IdentifierString("617200_16"), Definition=@1602
);
  @16161:OccurrenceTerminal( ElementOf=@16160, Definition=@1603 );
@16170:SingleOccurrence( Id=IdentifierString("617200_17"), Definition=@1602
);
  @16171:OccurrenceTerminal( ElementOf=@16170, Definition=@1603 );
@16180:SingleOccurrence( Id=IdentifierString("617200_18"), Definition=@1602
);
  @16181:OccurrenceTerminal( ElementOf=@16180, Definition=@1603 );
@16190:SingleOccurrence( Id=IdentifierString("617200_19"), Definition=@1602
);
  @16191:OccurrenceTerminal( ElementOf=@16100, Definition=@1603 );

# Cable
@2100:Part( PartTypes[i]=PartCategoryEnum(cable), PartTypes[i]=PartCatego-
ryEnum(raw_material_by_length) );
@2101:PartVersion;
@2103:Identifier( Id=IdentifierString("GAC861AH424S"), IdentificationCon-
text=@51 )
Part_with_ID_and_PartView(@2100, @2103, @2101, @2102, @4);
@2102:PartView;
  @21020:WirePartIdentification( ElementOf=@2102, DomainType="electrical",
code=@70 );
  @21021:WirePartIdentification( ElementOf=@2102, DomainType="electrical",
code=@71 );
```

```
  @21022:WirePartIdentification( ElementOf=@2102, DomainType="electrical",
code=@72 );
  @21023:WirePartIdentification( ElementOf=@2102, DomainType="electrical",
code=@73 );
  @21024:WirePartIdentification( ElementOf=@2102, DomainType="electrical",
code=@74 );
@2110:CableOccurrence( Id=IdentifierString("403-4S1"), Definition=@502,
Quantity=@2111 );
  @2111:NumericalValue( Unit=@8, ValueComponent=1.8 );
  @21120:WireOccurrenceIdentification( ElementOf=@2110,
Definition=@21020 );
  @21121:WireOccurrenceIdentification( ElementOf=@2110,
Definition=@21021 );
  @21122:WireOccurrenceIdentification( ElementOf=@2110,
Definition=@21022 );
  @21123:WireOccurrenceIdentification( ElementOf=@2110,
Definition=@21023 );
  @21124:WireOccurrenceIdentification( ElementOf=@2110,
Definition=@21024 );
  @21125:CableOccurrenceTerminalLocationGroup( ElementOf=@2110, Name="end
a" );
    @211250:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21120 );
    @211251:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21121 );
    @211252:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21122 );
    @211253:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21123 );
    @211254:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21124 );
  @21126:CableOccurrenceTerminalLocationGroup( ElementOf=@2110, Name="end
b" );
    @211260:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21120 );
    @211261:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21121 );
    @211262:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21122 );
    @211263:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21123 );
    @211264:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21124 );
@2120:CableOccurrence( Id=IdentifierString("403-4S2"), Definition=@502,
Quantity=@2111 );
  @2121:NumericalValue( Unit=@8, ValueComponent=1.8 );
  @21220:WireOccurrenceIdentification( ElementOf=@2120,
Definition=@21020 );
  @21221:WireOccurrenceIdentification( ElementOf=@2120,
Definition=@21021 );
  @21222:WireOccurrenceIdentification( ElementOf=@2120,
Definition=@21022 );
  @21223:WireOccurrenceIdentification( ElementOf=@2120,
Definition=@21023 );
  @21224:WireOccurrenceIdentification( ElementOf=@2120,
Definition=@21024 );
```

```
  @21225:CableOccurrenceTerminalLocationGroup( ElementOf=@2120, Name="end
a" );
     @211250:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21120 );
     @211251:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21121 );
     @211252:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21122 );
     @211253:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21123 );
     @211254:CableOccurrenceTerminal( ElementOf=@21125, AssociatedTrans-
portFeature=@21124 );
  @21126:CableOccurrenceTerminalLocationGroup( ElementOf=@2120, Name="end
b" );
     @211260:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21120 );
     @211261:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21121 );
     @211262:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21122 );
     @211263:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21123 );
     @211264:CableOccurrenceTerminal( ElementOf=@21126, AssociatedTrans-
portFeature=@21124 );
@2130:CableOccurrence( Id=IdentifierString("403-4S5"), Definition=@502,
Quantity=@2131 );
  @2131:NumericalValue( Unit=@8, ValueComponent=1.8 );
  @21300:WireOccurrenceIdentification( ElementOf=@2130,
Definition=@21020 );
  @21301:WireOccurrenceIdentification( ElementOf=@2130,
Definition=@21021 );
  @21302:WireOccurrenceIdentification( ElementOf=@2130,
Definition=@21022 );
  @21303:WireOccurrenceIdentification( ElementOf=@2130,
Definition=@21023 );
  @21304:WireOccurrenceIdentification( ElementOf=@2130,
Definition=@21024 );
  @21305:CableOccurrenceTerminalLocationGroup( ElementOf=@2130, Name="end
a" );
     @213050:CableOccurrenceTerminal( ElementOf=@21305, AssociatedTrans-
portFeature=@21120 );
     @213051:CableOccurrenceTerminal( ElementOf=@21305, AssociatedTrans-
portFeature=@21121 );
     @213052:CableOccurrenceTerminal( ElementOf=@21305, AssociatedTrans-
portFeature=@21122 );
     @213053:CableOccurrenceTerminal( ElementOf=@21305, AssociatedTrans-
portFeature=@21123 );
     @213054:CableOccurrenceTerminal( ElementOf=@21305, AssociatedTrans-
portFeature=@21124 );
  @21306:CableOccurrenceTerminalLocationGroup( ElementOf=@2110, Name="end
b" );
     @213060:CableOccurrenceTerminal( ElementOf=@21306, AssociatedTrans-
portFeature=@21120 );
     @213061:CableOccurrenceTerminal( ElementOf=@21306, AssociatedTrans-
portFeature=@21121 );
     @213062:CableOccurrenceTerminal( ElementOf=@21306, AssociatedTrans-
portFeature=@21122 );
```

```
    @213063:CableOccurrenceTerminal( ElementOf=@21306, AssociatedTrans-
portFeature=@21123 );
    @213064:CableOccurrenceTerminal( ElementOf=@21306, AssociatedTrans-
portFeature=@21124 );

# Wire
@2200:Part( PartTypes[i]=PartCategoryEnum(wire),
  PartTypes[i]=PartCategoryEnum(raw_material_by_length) );
@2201:PartVersion;
@2203:Identifier( Id=IdentifierString("04034-22-9"),
IdentificationContext=@52 )
Part_with_ID_and_PartView(@2200, @2203, @2201, @2202, @4);
@2202:PartView;
  @22021:WirePartIdentification( ElementOf=@2202, DomainType="electrical");
@2210:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22101 );
  @22101:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22102=WireOccurrenceIdentification( ElementOf=@2210, Definition=@22021 )
  @22103=WireOccurrenceTerminal( ElementOf=@2210, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22104=WireOccurrenceTerminal( ElementOf=@2210, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2220:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22201 );
  @22201:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22202=WireOccurrenceIdentification( ElementOf=@2220, Definition=@22021 )
  @22203=WireOccurrenceTerminal( ElementOf=@2220, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22204=WireOccurrenceTerminal( ElementOf=@2220, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2230:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22301 );
  @22301:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22302=WireOccurrenceIdentification( ElementOf=@2310, Definition=@22021 )
  @22303=WireOccurrenceTerminal( ElementOf=@2230, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22304=WireOccurrenceTerminal( ElementOf=@2230, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2240:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22401 );
  @22401:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22402=WireOccurrenceIdentification( ElementOf=@2240, Definition=@22021 )
  @22403=WireOccurrenceTerminal( ElementOf=@2240, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22404=WireOccurrenceTerminal( ElementOf=@2240, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
```

```
@2250:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22501 );
  @22501:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22502=WireOccurrenceIdentification( ElementOf=@2250, Definition=@22021 )
  @22503=WireOccurrenceTerminal( ElementOf=@2250, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22504=WireOccurrenceTerminal( ElementOf=@2250, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2260:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22601 );
  @22601:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22602=WireOccurrenceIdentification( ElementOf=@2260, Definition=@22021 )
  @22603=WireOccurrenceTerminal( ElementOf=@2260, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22604=WireOccurrenceTerminal( ElementOf=@2260, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2270:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22701 );
  @22701:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22702=WireOccurrenceIdentification( ElementOf=@2270, Definition=@22021 )
  @22703=WireOccurrenceTerminal( ElementOf=@2270, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22704=WireOccurrenceTerminal( ElementOf=@2270, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2280:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22801 );
  @22801:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22802=WireOccurrenceIdentification( ElementOf=@2280, Definition=@22021 )
  @22803=WireOccurrenceTerminal( ElementOf=@2280, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22804=WireOccurrenceTerminal( ElementOf=@2280, AssociatedTransportFea-
ture=@22102,
    Name="end b" );
@2290:WireOccurrence( Id=IdentifierString("W194C22-4"), Definition=@2202,
Quantity=@22901 );
  @22901:NumericalValue( Unit=@8, ValueComponent=2.490851 );
  @22902=WireOccurrenceIdentification( ElementOf=@2290, Definition=@22021 )
  @22903=WireOccurrenceTerminal( ElementOf=@2290, AssociatedTransportFea-
ture=@22102,
    Name="end a" );
  @22904=WireOccurrenceTerminal( ElementOf=@2290, AssociatedTransportFea-
ture=@22102,
    Name="end b" );

# EWH-Assembly
@9000:Part;
@9001:PartVersion;
@9003:ViewContext;
```

```
@9004:ViewContext;
Part_WiringHarnessAssemblyDesign_with_topology( @9000,
  "EWH Test-Case Connectivity5",@9001,@9002,@9003,@9004 );
@9002:WiringHarnessAssemblyDesign( Topology=@9901 );

@9101:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@11010 ); #
001A1P1X1
@9102:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@11020 ); #
002A1P1X1
@9103:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@12010 ); #
001A1P1XE
@9104:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@12020 ); #
002A1P1XE
@9105:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1311 ); #
001A1P1X1A
@9106:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1321 ); #
002A1P1X1A
@9107:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1411 ); #
001A1P1X1B
@9108:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1421 ); #
002A1P1X1B
@9109:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1510 ); #
001A1P1X1AQ1
@9110:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1520 ); #
001A1P1X1AQ1
@9111:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1530 ); #
001A1P1X1AQ1
@9112:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1540 ); #
002A1P1X1AQ1
@9113:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1550 ); #
002A1P1X1AQ1
@9114:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@1560 ); #
002A1P1X1AQ1
@9115:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16010 ); #
617200_1
@9116:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16020 ); #
617200_2
@9117:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16030 ); #
617200_3
@9118:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16040 ); #
617200_4
@9119:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16050 ); #
617200_5
@9120:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16060 ); #
617200_6
@9121:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16070 ); #
617200_7
@9122:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16080 ); #
617200_8
@9123:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16090 ); #
617200_9
@9124:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16100 ); #
617200_10
@9125:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16110 ); #
617200_11
@9126:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16120 ); #
617200_12
```

```
@9127:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16130 ); #
617200_13
@9128:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16140 ); #
617200_14
@9129:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16150 ); #
617200_15
@9130:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16160 ); #
617200_16
@9131:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16170 ); #
617200_17
@9132:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@16180 ); #
617200_19
@9141:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@2110 ); # 403-
4S1
@9142:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@2120 ); # 403-
4S2
@9143:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@2130 ); # 403-
4S5
@9151:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W194C22-4
@9152:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W194D22-4
@9153:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W194J22-4
@9154:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W194H22-4
@9155:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W195EA22-
4
@9156:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W195KA22-
4
@9157:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W302D22-4
@9158:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W302H22-4
@9159:NextAssemblyOccurrenceUsage( Relating=@9002, Related=@ ); # W304EA22-
4

# electrical AssemblyShapeJoints:
Joint2(@9002, @1511, @211250, "crimped_connection"); # TERM104
Joint2(@9002, @1512, @211251, "crimped_connection"); # TERM100
Joint2(@9002, @1513, @211252, "crimped_connection"); # TERM102
Joint2(@9002, @1514, @211253, "crimped_connection"); # TERM101
Joint2(@9002, @1515, @211254, "crimped_connection"); # TERM103

Joint2(@9002, @1521, @211260, "crimped_connection"); # TERM128
Joint2(@9002, @1522, @211261, "crimped_connection"); # TERM124
Joint2(@9002, @1523, @211262, "crimped_connection"); # TERM126
Joint2(@9002, @1524, @211263, "crimped_connection"); # TERM125
Joint2(@9002, @1525, @211264, "crimped_connection"); # TERM127

Joint2(@9002, @1531, @211250, "crimped_connection"); # TERM109
Joint2(@9002, @1532, @211251, "crimped_connection"); # TERM107
Joint2(@9002, @1533, @211252, "crimped_connection"); # TERM105
Joint2(@9002, @1534, @211253, "crimped_connection"); # TERM106
Joint2(@9002, @1535, @211254, "crimped_connection"); # TERM108

Joint2(@9002, @1541, @211260, "crimped_connection"); # TERM133
Joint2(@9002, @1542, @211261, "crimped_connection"); # TERM131
Joint2(@9002, @1543, @211262, "crimped_connection"); # TERM129
Joint2(@9002, @1544, @211263, "crimped_connection"); # TERM130
Joint2(@9002, @1545, @211264, "crimped_connection"); # TERM132
```

```
Joint2(@9002, @1551, @213050, "crimped_connection"); # TERM114
Joint2(@9002, @1552, @213051, "crimped_connection"); # TERM112
Joint2(@9002, @1553, @213052, "crimped_connection"); # TERM110
Joint2(@9002, @1554, @213053, "crimped_connection"); # TERM111
Joint2(@9002, @1555, @213054, "crimped_connection"); # TERM113

Joint2(@9002, @1561, @213060, "crimped_connection"); # TERM138
Joint2(@9002, @1562, @213061, "crimped_connection"); # TERM136
Joint2(@9002, @1563, @213062, "crimped_connection"); # TERM134
Joint2(@9002, @1564, @213063, "crimped_connection"); # TERM135
Joint2(@9002, @1565, @213064, "crimped_connection"); # TERM137

Joint2(@9002, @16011, @22103, "crimped_connection"); # TERM116
Joint2(@9002, @16021, @22203, "crimped_connection"); # TERM117
Joint2(@9002, @16031, @22303, "crimped_connection"); # TERM118
Joint2(@9002, @16041, @22403, "crimped_connection"); # TERM119
Joint2(@9002, @16051, @22503, "crimped_connection"); # TERM121
Joint2(@9002, @16061, @22603, "crimped_connection"); # TERM122
Joint2(@9002, @16071, @22703, "crimped_connection"); # TERM120
Joint2(@9002, @16081, @22803, "crimped_connection"); # TERM115
Joint2(@9002, @16091, @22903, "crimped_connection"); # TERM123

Joint2(@9002, @16111, @22104, "crimped_connection"); # TERM140
Joint2(@9002, @16121, @22204, "crimped_connection"); # TERM141
Joint2(@9002, @16131, @22304, "crimped_connection"); # TERM142
Joint2(@9002, @16141, @22404, "crimped_connection"); # TERM143
Joint2(@9002, @16151, @22504, "crimped_connection"); # TERM145
Joint2(@9002, @16161, @22604, "crimped_connection"); # TERM146
Joint2(@9002, @16171, @22704, "crimped_connection"); # TERM144
Joint2(@9002, @16181, @22804, "crimped_connection"); # TERM139
Joint2(@9002, @16191, @22904, "crimped_connection"); # TERM147

# mechanical AssemblyShapeJoints:
Joint2(@9002, @1517, @13111, "snap_connection"); # 001A1P1X1AQ1 into
001A1P1X1A/1
Joint2(@9002, @1527, @13112, "snap_connection"); # 001A1P1X1AQ2 into
001A1P1X1A/2
Joint2(@9002, @1537, @13113, "snap_connection"); # 001A1P1X1AQ3 into
001A1P1X1A/3

Joint2(@9002, @1547, @13211, "snap_connection"); # 002A1P1X1AQ1 into
002A1P1X1A/1
Joint2(@9002, @1557, @13212, "snap_connection"); # 002A1P1X1AQ2 into
002A1P1X1A/2
Joint2(@9002, @1567, @13213, "snap_connection"); # 002A1P1X1AQ3 into
002A1P1X1A/3

Joint2(@9002, @16011, @141101, "snap_connection"); # 617200_1 into
001A1P1X1B/1
Joint2(@9002, @16021, @141102, "snap_connection"); # 617200_2 into
001A1P1X1B/2
Joint2(@9002, @16031, @141103, "snap_connection"); # 617200_3 into
001A1P1X1B/3
```

```
Joint2(@9002, @16041, @141104, "snap_connection"); # 617200_4 into
001A1P1X1B/4
Joint2(@9002, @16051, @141105, "snap_connection"); # 617200_5 into
001A1P1X1B/5
Joint2(@9002, @16061, @141106, "snap_connection"); # 617200_6 into
001A1P1X1B/6
Joint2(@9002, @16071, @141109, "snap_connection"); # 617200_7 into
001A1P1X1B/9
Joint2(@9002, @16081, @141113, "snap_connection"); # 617200_8 into
001A1P1X1B/13
Joint2(@9002, @16091, @141114, "snap_connection"); # 617200_9 into
001A1P1X1B/14

Joint2(@9002, @16101, @142101, "snap_connection"); # 617200_10 into
002A1P1X1B/1
Joint2(@9002, @16111, @142102, "snap_connection"); # 617200_11 into
002A1P1X1B/2
Joint2(@9002, @16121, @142103, "snap_connection"); # 617200_12into
002A1P1X1B/3
Joint2(@9002, @16131, @142104, "snap_connection"); # 617200_13 into
002A1P1X1B/4
Joint2(@9002, @16141, @142105, "snap_connection"); # 617200_14 into
002A1P1X1B/5
Joint2(@9002, @16151, @142106, "snap_connection"); # 617200_15 into
002A1P1X1B/6
Joint2(@9002, @16161, @142109, "snap_connection"); # 617200_16 into
002A1P1X1B/9
Joint2(@9002, @16171, @142113, "snap_connection"); # 617200_17 into
002A1P1X1B/13
Joint2(@9002, @16181, @142114, "snap_connection"); # 617200_19 into
002A1P1X1B/14

Joint2(@9002, @13114, @11011, "screwed_connection"); # 001A1P1X1A into
001A1P1X1/A
Joint2(@9002, @141100, @11012, "screwed_connection"); # 001A1P1X1B into
001A1P1X1/B
Joint2(@9002, @120101, @11013, "screwed_connection"); # 001A1P1XE  into
001A1P1X1/(backside)

Joint2(@9002, @13214, @11021, "screwed_connection"); # 002A1P1X1A into
002A1P1X1/A
Joint2(@9002, @142100, @11022, "screwed_connection"); # 002A1P1X1B into
002A1P1X1/B
Joint2(@9002, @120201, @11023, "screwed_connection"); # 002A1P1XE  into
002A1P1X1/(backside)

@9801:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99201, Attached-
Feature=@ );
@9802:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99202, Attached-
Feature=@ );
@9803:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99203, Attached-
Feature=@ );
@9804:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99204, Attached-
Feature=@ );
@9805:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99205, Attached-
Feature=@ );
```

```
@9806:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99206, Attached-
Feature=@ );
@9807:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99207, Attached-
Feature=@ );
@9808:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99208, Attached-
Feature=@ );
@9809:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99209, Attached-
Feature=@ );
@9810:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99210, Attached-
Feature=@ );
@9811:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99211, Attached-
Feature=@ );
@9812:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99212, Attached-
Feature=@ );
@9813:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99213, Attached-
Feature=@ );
@9814:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99214, Attached-
Feature=@ );
@9815:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99215, Attached-
Feature=@ );
@9816:HarnessNode( ElementOf=@9002, RepresentedGeometry=@99216, Attached-
Feature=@ );

@9900:GeometricCoordinateSpace( Units=@8, DimensionCount=1 );
@9901:EdgeBasedTopologicalRepresentationWithLengthConstraint(
 Items=(@9902), ContextOfItems=@9900 );
@9902:ConnectedEdgeSet( ConnectedEdges=(@99301,@99302,@99303,@99304,@99305,
@99306,

@99307,@99308,@99309,@99310,@99311 ) );

@99101:Point();
@99102:Point();
@99103:Point();
@99104:Point();
@99105:Point();
@99106:Point();
@99107:Point();
@99108:Point();
@99109:Point();
@99110:Point();
@99111:Point();
@99112:Point();
@99113:Point();
@99114:Point();
@99115:Point();
@99116:Point();

@99201:VertexPoint( name='N1002' VertexGeometry=@99101 );
@99202:VertexPoint( name='N1003' VertexGeometry=@99102 );
@99203:VertexPoint( name='N1005' VertexGeometry=@99103 );
@99204:VertexPoint( name='N1006' VertexGeometry=@99104 );
@99205:VertexPoint( name='N1008' VertexGeometry=@99105 );
@99206:VertexPoint( name='N1009' VertexGeometry=@99106 );
@99207:VertexPoint( name='N1010' VertexGeometry=@99107 );
```

```
@99208:VertexPoint( name='N1011' VertexGeometry=@99108 );
@99209:VertexPoint( name='N1012' VertexGeometry=@99109 );
@99210:VertexPoint( name='N1013' VertexGeometry=@99110 );
@99211:VertexPoint( name='N1014' VertexGeometry=@99111 );
@99212:VertexPoint( name='N1015' VertexGeometry=@99112 );
@99213:VertexPoint( name='N1016' VertexGeometry=@99113 );
@99214:VertexPoint( name='N1017' VertexGeometry=@99114 );
@99215:VertexPoint( name='N1020' VertexGeometry=@99115 );
@99216:VertexPoint( name='N1021' VertexGeometry=@99116 );

@99301:EdgeBoundedCurveWithLength( name='BUN802', EdgeGeometry=@99401 );
undirected_edge(@9931, @9921, @9923)
@99302:EdgeBoundedCurveWithLength( name='BUN803', EdgeGeometry=@99402 );
undirected_edge(@9932, @9922, @9923)
@99303:EdgeBoundedCurveWithLength( name='BUN804', EdgeGeometry=@99403 );
undirected_edge(@9933, @9923, @9924);
@99304:EdgeBoundedCurveWithLength( name='BUN805', EdgeGeometry=@99404 );
undirected_edge(@9934, @9924, @9925);
@99305:EdgeBoundedCurveWithLength( name='BUN806', EdgeGeometry=@99405 );
undirected_edge(@9935,@9924,@9926);
@99306:EdgeBoundedCurveWithLength( name='BUN807', EdgeGeometry=@99406 );
undirected_edge(@9935,@9924,@9926);
@99307:EdgeBoundedCurveWithLength( name='BUN808', EdgeGeometry=@99407 );
undirected_edge(@9935,@9924,@9926);
@99308:EdgeBoundedCurveWithLength( name='BUN809', EdgeGeometry=@99408 );
undirected_edge(@9935,@9924,@9926);
@99309:EdgeBoundedCurveWithLength( name='BUN810', EdgeGeometry=@99409 );
undirected_edge(@9935,@9924,@9926);
@99310:EdgeBoundedCurveWithLength( name='BUN811', EdgeGeometry=@99410 );
undirected_edge(@9935,@9924,@9926);
@99311:EdgeBoundedCurveWithLength( name='BUN812', EdgeGeometry=@99411 );
undirected_edge(@9935,@9924,@9926);

@99401:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.381) );
@99402:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.635) );
@99403:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(1.077468)
);
@99404:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(1.170686)
);
@99405:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.889) );
@99406:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(1.591056)
);
@99407:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(1.655826)
);
@99408:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.889) );
@99409:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.635) );
@99410:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.381) );
@99411:BoundedCurveWithLength( CurveLength=PositiveLengthMeasure(0.74041) )
;

);
```