Interface Description V1.0

Overview

The robot control software KUKA.PickControl is able to read in the output file of the mixed palletizing software and converts this file into individual robot movements.

For a collision free pallet building it is necessary to specify additional approach points beside the final place position.

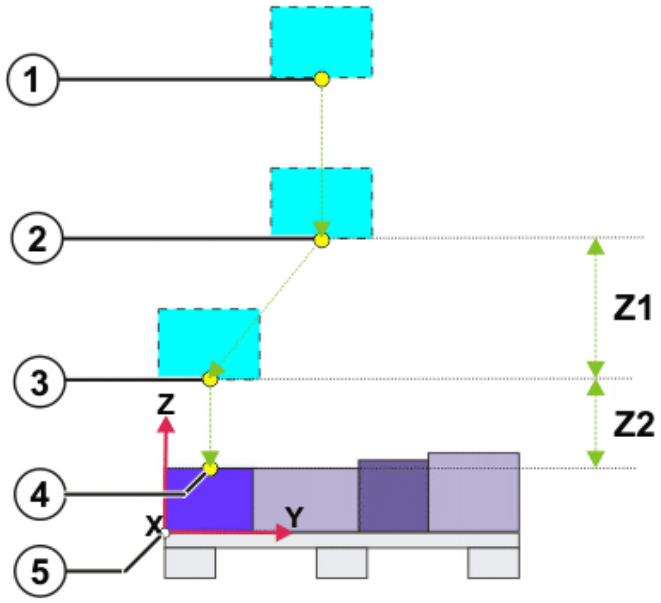


Figure 1: Definition of the approach points and coordinate system

1	Approach position 1
2	Approach position 2
3	Approach position 3
4	Final place position
5	Pallet coordinate system
X	X-Axis along the long side of the pallet
Y	Y-Axis along the short side of the pallet
Z1	Distance between the approach point 2 and 3
Z2	Distance between the approach point 3 and the final place position

In Figure 2 the pallet coordinate system and a typical pallet overhang is defined. The X-Axis is usually along the longer side of the pallet.

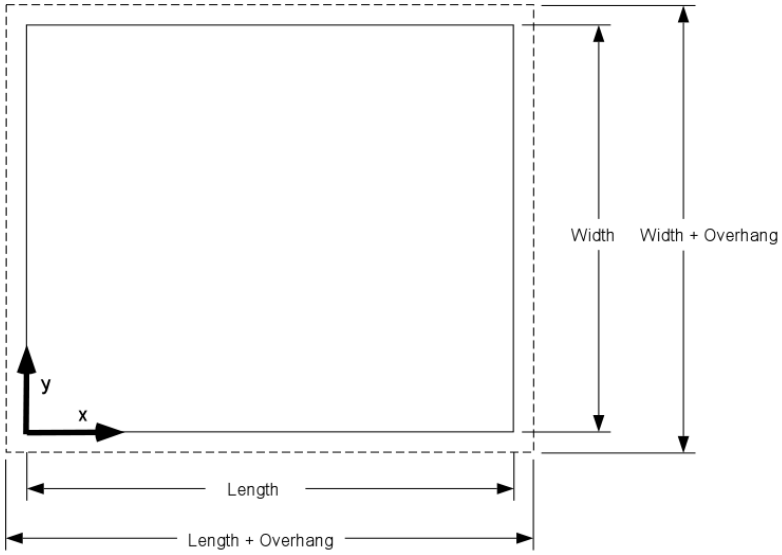


Figure 2: Pallet Coordinate System and Overhang definition

Input File: Order File

Overview

The order.xml file contains the following data:

- Initialization parameters for the pallets: <PalletInit>…</PalletInit>
- Order data: <Order> … </Order>
    - Order Number and definition of product grouping
    - List of all ordered articles with article parameters and corresponding barcodes

Example:

```
<Message index="1">
                    <PalletInit>
                       <Pallets>
                          <Pallet>
                             <PalletNumber>1</PalletNumber>
                             <Description>Euro Pallet</Description>
                             <Dimensions>
                                <Length>940</Length>
                                <Width>940</Width>
                                <MaxLoadHeight>1700</MaxLoadHeight>
                                <MaxLoadWeight>1000000</MaxLoadWeight>
                             </Dimensions>
                             <Overhang>
                                <Length>26</Length>
                                <Width>26</Width>
                             </Overhang>
                             <SecurityMargins>
                                <Length>0</Length>
                                <Width>0</Width>
                             </SecurityMargins>
                          </Pallet>
                       </Pallets>
                    </PalletInit>
                    <Order>
                       <ID>00011380</ID>
                       <Description />
                       <Restrictions>
                          <FamilyGrouping>False</FamilyGrouping>
                          <Ranking>False</Ranking>
                       </Restrictions>
                       <OrderLines>
                          <OrderLine>
                             <OrderLineNo>1</OrderLineNo>
                             <Article>
                                <ID>11</ID>
                                <Description>20oz PET Singles</Description>
                                <Type>1</Type>
                                <Length>470</Length>
                                <Width>311</Width>
                                <Height>241</Height>
                                <Weight>16000</Weight>
                                <Family>4</Family>
                             </Article>
                             <Barcodes>
                                <Barcode>110001</Barcode>
                                <Barcode>110002</Barcode>
                             </Barcodes>
```

```
                        </OrderLine>
                        <OrderLine>
                           <OrderLineNo>2</OrderLineNo>
                           ...
                        </OrderLine>
                     </OrderLines>
                  </Order>
</Message>
```

Pallet Init: <PalletInit> … </PalletInit>

Parameter	Description
Pallet Number	Pallet number
Description	Name of the pallet, e.g. “Euro Pallet”, CHEP Pallet, US Pallet, etc.

Pallet dimension: <Dimensions> … </Dimension

Parameter	Description
Length	Length of the pallet in X direction in [mm]
Width	Width of the pallet in Y direction in [mm]
MaxLoadHeight	Maximum load height of the pallet in Z direction in [mm]
MaxLoadWeight	Maximum weight of the pallet in [g]

Overhang: <Overhang> … </Overhang>

Parameter	Description
Length	Allowed overhang along the length side in X direction in [mm]
Width	Allowed overhang along the width side in Y direction in [mm]

SecurityMargin: <SecurityMargin> … </SecutiryMargin>

Parameter	Description
Length	Safety distance between the cases along the length side in X direction in [mm]
Width	Safety distance between the cases along the width side in Y direction in [mm]

Order Data: <Order> … </Order>

Parameter	Description
ID	Unique Order ID

Article Grouping: <Restrictions> … </Restrictions>

Parameter	Description
Family Grouping	Family grouping enabled (True) or disabled

	(False) Default: False
Ranking	Ranking enabled (True) or disabled (False) Default: False

Order Line: <OrderLine> … </OrderLine>

Parameter	**Description**
OrderLineNo	Incrementing number for each order line

Article Data: <Article> … </Article>

<table>
<tr><th>Parameter</th><th colspan="2">Description</th></tr>
<tr><td>ID</td><td colspan="2">Unique identifier of the article</td></tr>
<tr><td>Description</td><td colspan="2">Name of the article</td></tr>
<tr><td>Type</td><td colspan="2">Packaging Type:
1: Square box
Currently only value 1 is allowed</td></tr>
<tr><td>Length</td><td>Length of the case in [mm]</td><td rowspan="3">Length x Width are specifying the bottom of the case.
The length value should be larger than the width value</td></tr>
<tr><td>Width</td><td>Width of the case in [mm]</td></tr>
<tr><td>Height</td><td>Height of the case in [mm]</td></tr>
<tr><td>Weight</td><td colspan="2">Weight of the case in [g]</td></tr>
<tr><td>Family</td><td colspan="2">Number of the family group to which this case belongs to.
Only relevant if Parameter <FamilyGrouping> was set to True.</td></tr>
</table>

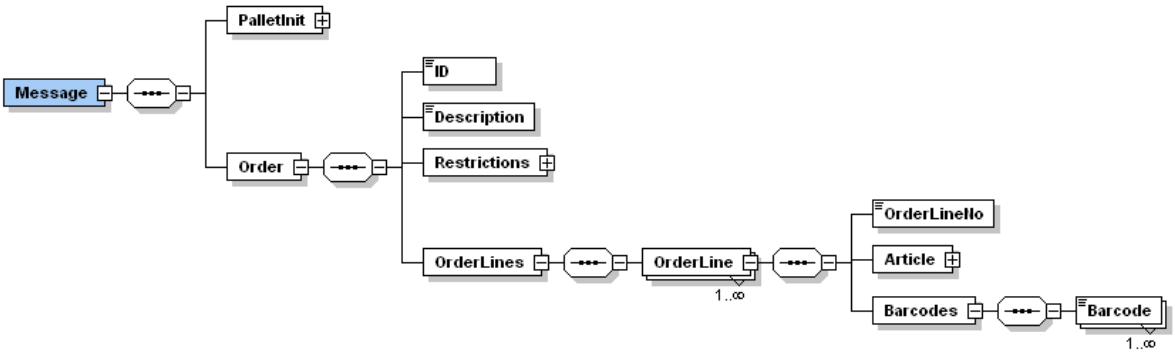
Data about potential sub units in a case: <Barcodes> … </Barcodes>

Parameter	Description
Barcode	Barcode The number of barcodes corresponds to the number of ordered cases.

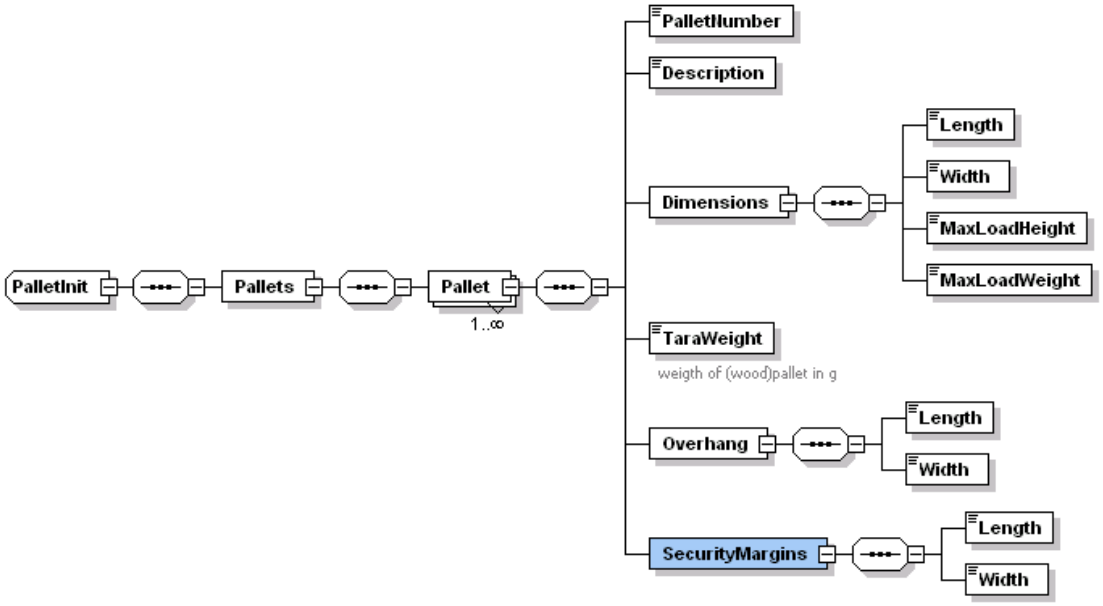
Schema File

The input file is described in a set of schema files in order to check the format on correctness.

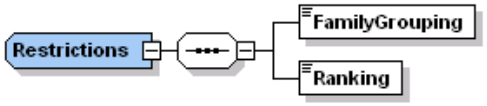
OffLineMessage.xsd


Message
PalletInit
Order
ID
Description
Restrictions
OrderLines
OrderLine
1..∞
OrderLineNo
Article
Barcodes
Barcode
1..∞

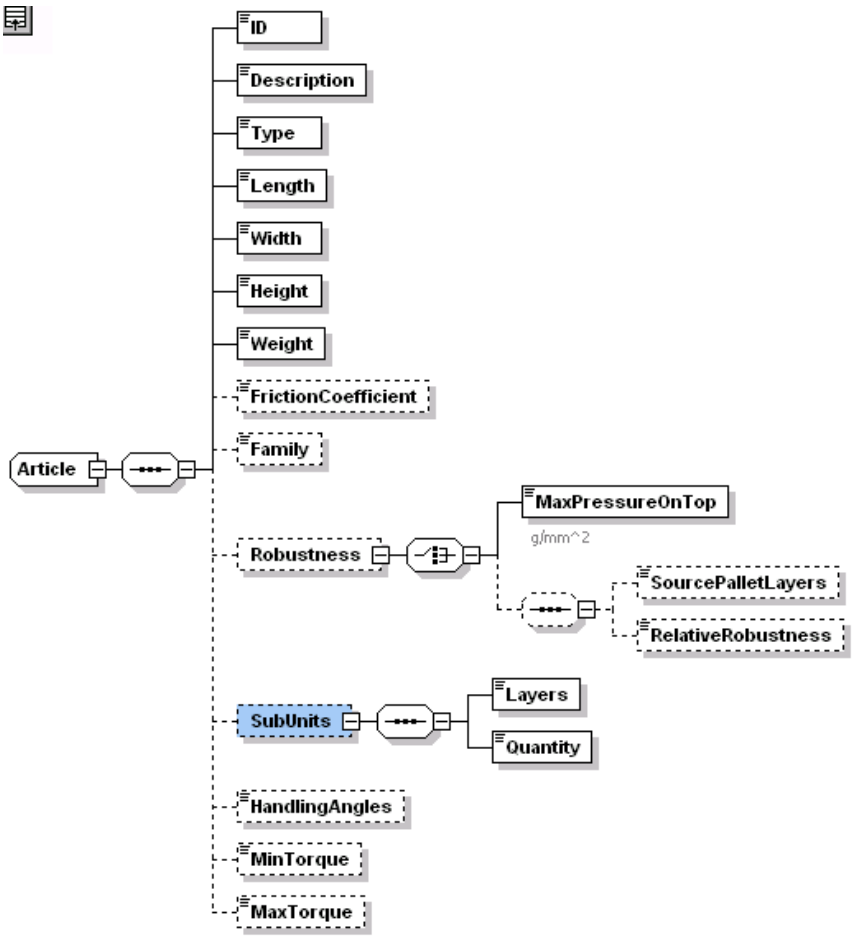
PalletInit.xsd



Restrictions.xsd



Article.xsd



Output File: Packlist File

Overview

The mixed palletizing software has to calculate the stacking sequence, the placement coordinates and three collision free approach points for each ordered case. Depending on the order volume the software may stack the cases on more than one pallet.

```
<Response>
                  <PackList>
                     <OrderID>00011380</OrderID>
                     <PackPallets>
                        <PackPallet>
                           <PalletNumber>1</PalletNumber>
                           <Description>EuroPallet</Description>
                           <Dimensions>
                              <Length>940</Length>
                              <Width>940</Width>
                              <MaxLoadHeight>1700</MaxLoadHeight>
                              <MaxLoadWeight>1000000</MaxLoadWeight>
                           </Dimensions>
                           <Packages>
                              <Package>
                                 <PackSequence>1</PackSequence>
                                 <IncomingSequence>1</IncomingSequence>
                                 <OrderLineNo>5</OrderLineNo>
                                 <ParentLayer>0</ParentLayer>
                                 <Article>
```

```
                                    <ID>146</ID>
                                    <Description>12oz 12pk FM</Description>
                                    <Type>1</Type>
                                    <Length>398</Length>
                                    <Width>132</Width>
                                    <Height>124</Height>
                                    <Weight>5000</Weight>
                                    <Family>1</Family>
                                    <Rank>1</Rank>
                                    <MaxRankOnTop>1</MaxRankOnTop>
                                    <HandlingAngles>All</HandlingAngles>
                                    <MinTorque>10</MinTorque>
                                    <MaxTorque>100</MaxTorque>
                                 </Article>
                                 <Barcode>1460002</Barcode>
                                 <PlacePosition>
                                    <X>767</X>
                                    <Y>900</Y>
                                    <Z>124</Z>
                                 </PlacePosition>
                                 <Orientation>1</Orientation>
                                 <ApproachPoint1>
                                    <X>60</X>
                                    <Y>-60</Y>
                                    <Z>50</Z>
                                 </ApproachPoint1>
                                 <ApproachPoint2>
                                    <X>60</X>
                                    <Y>-60</Y>
                                    <Z>50</Z>
                                 </ApproachPoint2>
                                 <ApproachPoint3>
                                    <X>0</X>
                                    <Y>0</Y>
                                    <Z>3</Z>
                                 </ApproachPoint3>
                                 <StackHeightBefore>0</StackHeightBefore>
                              </Package>
                              <Package>
                                 <PackSequence>2</PackSequence>
                                 ...
                              </Package>
                           </Packages>
                        </PackPallet>
                     </PackPallets>
                  </PackList>
</Response>
```

Order Data: <PackList> … </PackList>

Parameter	Description
OrderID	Unique order number extracted from the ORDER.XML file

Pallet Data:

Parameter	Description
Pallet Number	Pallet number
Description	Name of the pallet, e.g. “Euro Pallet”, CHEP Pallet, US Pallet, etc.

Pallet dimension: <Dimensions> … </Dimension

Parameter	Description
Length	Length of the pallet in X direction in [mm]
Width	Width of the pallet in Y direction in [mm]
MaxLoadHeight	Maximum load height of the pallet in Z direction in [mm]
MaxLoadWeight	Maximum weight of the pallet in [g]

Package Data:

Parameter	Description
PackSequence	Sequence number in which the package has to placed on to the pallet
IncomingSequence	Sequence number in with the package has to be conveyed into the cell Note: In the offline mixed palletizing environment the PackSequence and the IncomingSequence have to be identical
OrderLineNo	Unique number extracted from the ORDER.XML file
ParentLayer	Layer number of the pallet on which the package will be placed to

Article Data: <Article> … </Article>

Parameter	Description
ID	Unique identifier of the article
Description	Name of the article
Type	Packaging Type:

	• 1: Square box Currently only value 1 is allowed
Length	Length of the case in [mm]
Width	Width of the case in [mm]
Height	Height of the case in [mm]
Weight	Weight of the case in [g]
Family	Number of the family group to which this case belongs to. Only relevant if Parameter <FamilyGrouping> was set to True.
Rank	Number of the fragility class to which this case belongs to. Only relevant if Parameter <Ranking> was set to True.
MaxRankOnTop	Specifies the maximum rank class of cases, which can be placed on top of this case
HandlingAngles	Allowed gripper orientation during the pick up on the conveyor. Default: All
MinTorque	Not used
MaxTorque	Not used

Parameter	**Description**
Barcode	Barcode of the case extracted from the ORDER.XML file.

Approach Strategy:

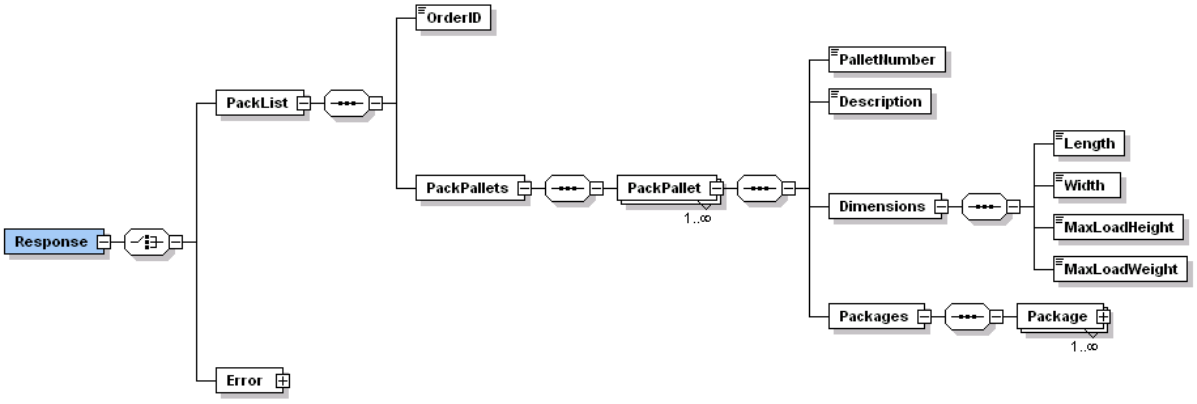
Parameter	**Description**
PlacePosition	Final place position of the case on the pallet • X: Position in X direction of the pallet • Y: Position in Y direction of the pallet • Z: Position in Z direction of the pallet All units are in [mm]
Orientation	Orientation of the case on the pallet in reference to the pallet coordinate system:

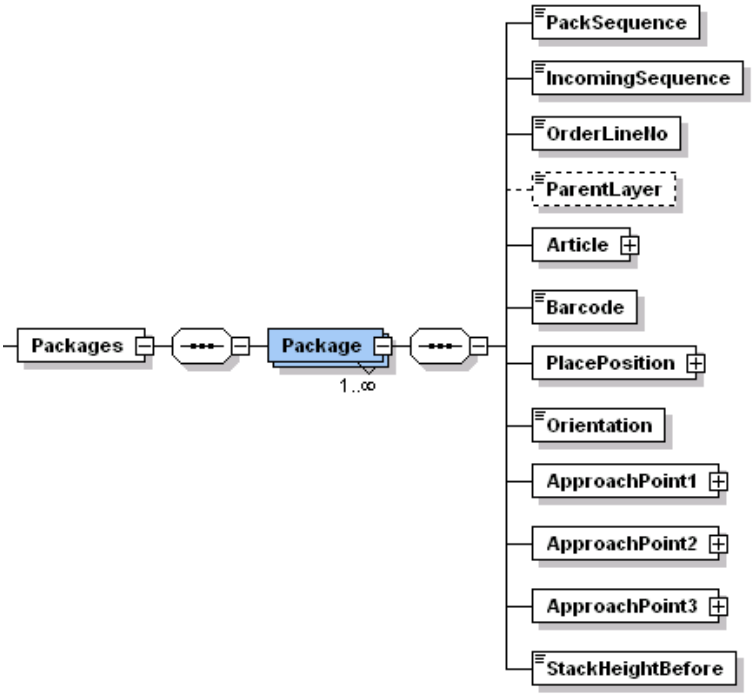
	• 1: 0°; the long side of the case is parallel to the X direction of the coordinate system • 2: 90°; the long side of the case is parallel to the Y direction of the coordinate system

Parameter	Description
ApproachPoint1 … ApproachPoint3	Approach position above the pallet. The coordinates of the approach points are relative to the place positions on the pallet • X: Relative position in X-direction • Y: Relative position in Y-direction • Z: Relative position in Z-direction
StackHeightBefore	Highest Point on the pallet before placing the current case

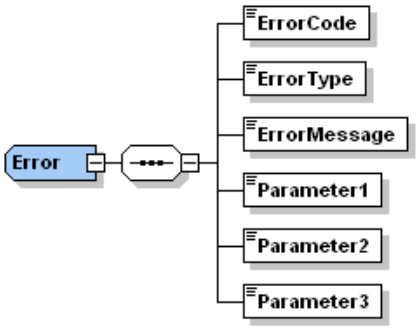
Schema Files

OffLineResponse.xsd




Packages
Package
1..∞
PackSequence
IncomingSequence
OrderLineNo
ParentLayer
Article
Barcode
PlacePosition
Orientation
ApproachPoint1
ApproachPoint2
ApproachPoint3
StackHeightBefore

OffLineResponse.xsd



Point.xsd