

Operating Manual
Painting PowerPac 5.13.01

Table of Contents

1.1 About Painting PowerPac.....	5
1.2 Terms and Concepts	6
Installation.....	7
2.1 System Requirements	7
2.2 Requesting and Installing a License Key.....	8
2.3 Getting Started.....	9
Painting PowerPac.....	10
3.1 Painting support in RobotStudio.....	10
3.2 Event Visualization.....	11
Navigating Painting PowerPac.....	12
4.1 Painting PowerPac.....	12
4.2 The Painting Ribbon Tab	13
4.3 The Browser Tab	15
Workflow for Painting PowerPac.....	16
5.1 Workflow for Painting PowerPac	16
5.2 How to Create a Paint Station	18
5.3 Import Workpiece.....	23
5.4 Create Panel	27
5.5 Panel browser tab.....	29
5.6 Process Workpiece and Split Panel	33
5.7 Create Brush Specification	42
5.8 Create Paint Specification.....	45
5.9 How to create user Preferences	47
5.10 How to create a new paint program.....	49
5.11 How to Create Manual PaintStrokes	51
5.12 Target Orientation.....	54
5.13 Auto PaintStroke.....	57
5.14 How to specify a Painting Sequence.....	67
5.15 How to load existing Paint Programs.....	69
5.16 Brush Tables and Virtual Applicator.....	70
5.17 How to work with Job Queue	78
5.18 How to work with Virtual CBS.....	83
5.19 Virtual Fluid Device	86

5.20 Painting Browser options.....	89
5.21 Insert PaintStroke.....	95
5.22 Modify PaintStroke	96
5.23 Delete PaintStroke.....	97
5.24 Delete Instruction.....	98
5.25 Insert Event.....	99
5.26 Modify Instruction	100
5.29 Modify and Delete Event	101
5.28 Create Grid	103
5.27 Spray Angle	105
5.30 Adjust Position and Orientation.....	108
5.31 Teach Position.....	109
5.32 Synchronization	110

1.1 About Painting PowerPac

The Painting PowerPac is a RobotStudio solution for offline programming and simulation of Paint application. It will reduce installation and programming time, since programming and installation of new robots can be performed offline without disturbing ongoing production.

It can be used for verification of the paint line layout and painting programs. Possible program weaknesses, such as singularity, speed deviations etc., can be discovered before production start. Cycle time and robot positioning challenges can be discovered at an early stage instead of after installation. It shall be possible to simulate the Production sequence and visualize bottlenecks and get an estimate on paint parameters.

Use the Painting PowerPac for controlling a range of features of the paint process. It supports such as

- Setting up the Paint cell
- Creating and editing of brush specifications
- Creating Paint_Strokes
- Setting and editing Events
- Setting up the Production sequence using Job Queue
- Estimating volume of Paint material consumed for a program
- Connecting to the "Virtual Applicator" to get Brush tables using the Service

NOTE! – Painting PowerPac shall work with Paint systems only

1.2 Terms and Concepts

Painting PowerPac concepts

The terminologies and concepts that are used in The Painting PowerPac are as below.

	Concept	Description
1	Brush Specification	Brush Specification is a table of brush properties used by Painting PowerPac for displaying purposes, as a supplement to the “standard” Brush Tables. It contains information about the Brush Width, Length, Color, Pitch, Spray Distance and TCP Velocity associated with a Brush number. These Brush Properties are not used by the robot controller. directly, but is used by Painting PowerPac to generate paint programs.
2	PaintStroke	PaintStroke is the term used to identify a group of <i>PaintL</i> & <i>SetBrush</i> instructions between the Start and End of a Paint sequence.
3	Paint Specification	Paint Specification contains information about the characteristics of the paint material such as the Nominal Thickness, its Density and Solid Content information. These parameters are used when user wants to access the Virtual Applicator services
4	Panel	Unique segments of a workpiece can be grouped together and saved as a Panel. Ex: Door, Hood etc Panels are used while generating path using the Auto PaintStroke feature.

Installation

2.1 System Requirements

To work with Painting PowerPac, the following is required:

Prerequisites

To start the installation process, the following must be available:

- A computer that meets or exceeds the system requirements as specified by RobotStudio.
- A log on account with administrator rights on the computer.
- RobotStudio 5.13 or higher version installed on the computer.

Recommended Hardware

CPU: 2.0 GHz or faster processor
Memory: 1 GB RAM or more (More is recommended.)

Available disk space: 5+ GB on the system disk, 250+ MB on the installation disk

Graphics card: High performance OpenGL-compatible graphics card with the corresponding up-to-date drivers installed

Screen resolution: 1280 x 1024 pixels (Recommended)

Colors: 256 or higher

DPI: Normal size (96 dpi)

Mouse: Three-button mouse

Software Requirements

Microsoft Windows XP Professional with Service Pack 3

Microsoft Windows Vista or Windows 7

RobotStudio 5.13 or higher

2.2 Requesting and Installing a License Key

Overview

The license certificate is a document that contains ABB contact information, an activation key, a list of licensed products and an expiration date.

Please refer to the RobotStudio for more information on Licensing.

Prerequisites

You cannot use Painting PowerPac until you have obtained your license key. The license key is valid only on the computer on which RobotStudio and Painting PowerPac are installed.

The license key is invalidated if you change your file system, for instance, from FAT32 to NTFS.

Requesting a License Key

To request your license key, follow these steps:

1. Log on to your computer.
2. Launch RobotStudio and then navigate to **Information – Manage Licences**
3. Click on Activation Wizard and select I want to request a licence file
4. Enter the Activation key received along with RobotStudio. This contains information about the Painting PowerPac option if selected when user has ordered RobotStudio.
5. Save the report and upload the file to the SOFA server.
6. On receiving the Licence key, User can install Manually or Activate over Internet

Users can work with Painting PowerPac for a trial period of 30 days. The trial period license file 'PaintingPowerPac_5.13_KEY.bin' can be found installation folder of Painting PowerPac folder, usually in C:\Program Files\ABB Industrial IT\RoboticsIT\Painting PowerPac 5.13. This key can be activated as specified above.

After the trial period is over, licence must be procured and activated to continue to use Painting PowerPac. Virtual Applicator functionality shall not be available during the trial period.

2.3 Getting Started

How to Start Painting PowerPac

Follow these steps to start The Painting PowerPac:

1. Create a new paint station, or open an existing paint station by using RobotStudio.
2. Click **Painting** in the **PowerPacs** group of the **Add-ins** tab on the Ribbon.

NOTE! Painting PowerPac cannot be activated without a station having an active paint controller running.

How to Stop Painting PowerPac

To stop Painting PowerPac, click **Painting** again on the **Add-ins** tab or click

Close Painting PowerPac in the Quick Access Toolbar.

Painting PowerPac

3.1 Painting support in RobotStudio

Paint Manipulator libraries are integrated into RobotStudio and are available as template systems from RobotStudio 5.13.01. The available systems are

Robot Type	Manipulator Variant	RS Model Name
IRB 52	std vertical arm (Right & Left)	IRB52_12_700_1005__01.rslib
IRB 52	short vertical arm (Right & Left)	IRB52_12_475_1005__01.rslib
IRB 540 -12	standard arm (Right & Left)	IRB540_12_1000_1620__01.rslib
IRB 580-12	short arm (Right & Left) & standard arm w/MTB (Right & Left)	IRB580_12_1000_1220__01.rslib
IRB 580-12	standard arm (Right & Left) & standard arm w/MTB (Right & Left)	IRB580_12_1000_1620__01.rslib
IRB 5400-12	std arm (Right & Left)	IRB5400_13_1200_1620__01.rslib
IRB 5400-12	std arm axis 2 + 60 deg	IRB5400_12_1200_1620_60P_01.rslib
IRB 5400-13	std arm (Right & Left)	IRB5400_13_1200_1620__01.rslib
IRB 5400-13	std arm axis 2 + 60 deg	IRB5400_13_1200_1620_60P_01.rslib
IRB 5400-14	std arm (Right & Left)	IRB5400_14_1200_1620__01.rslib
IRB 5400-14	std arm axis 2 + 60 deg	IRB5400_14_1200_1620_60P_01.rslib
IRB 5400-22	process arm (Right & Left)	IRB5400_22_1200_1620__01.rslib
IRB 5400-23	process arm (Right & Left)	IRB5400_23_1200_1620__01.rslib
IRB 5400-24	process arm (Right & Left)	IRB5400_24_1200_1620__01.rslib
IRB 5500	AType_b80 & BType_b80	IRB5500_35A_1300_1720__01.rslib

Motion instructions

Process templates functionality provides support (including synchronization) for arbitrary motion instructions. The templates for *PaintL* & *SetBrush* are added and set as default when the user activates the Painting PowerPac from the addins tab.

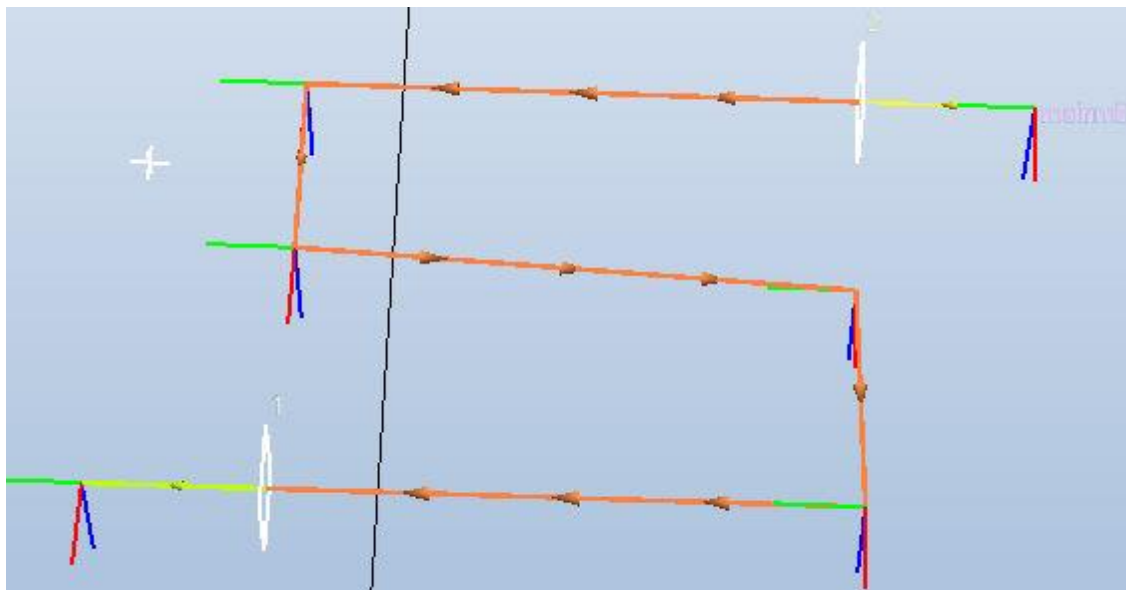
Action Instructions

The process template functionality of RobotStudio provides support for including Action instructions *SetBrush*, *UseBrushTab*, *WaitWobj*, *DropWobj* etc. The parameters for the action instructions can also be specified from RobotStudio.

In Painting PowerPac *SetBrush* instruction is automatically loaded once the PowerPac is activated.

3.2 Event Visualization

SetBrush events are represented graphically as indicated below, with a white square crossing the path..



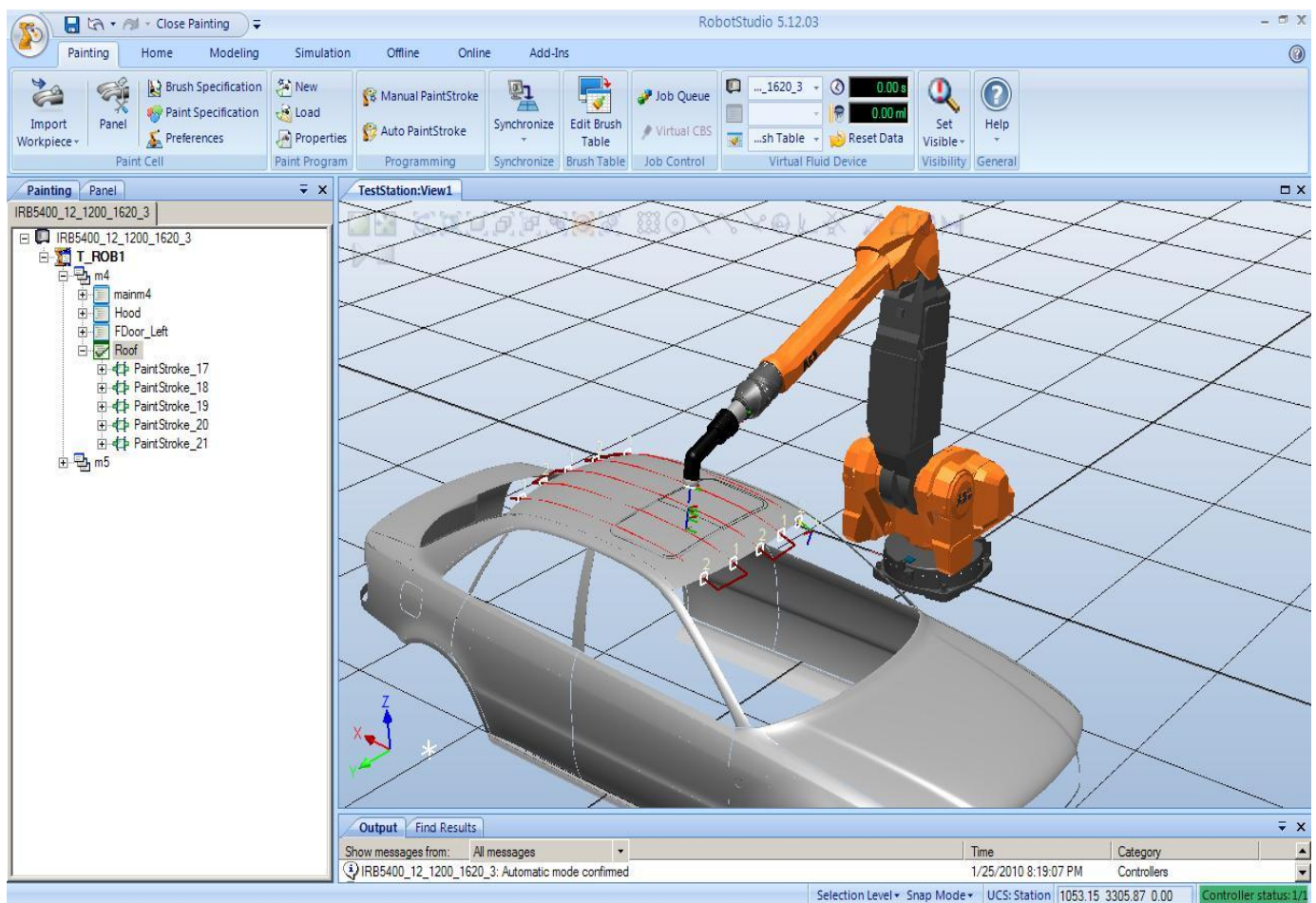
The color of the path between events are also set based on the Brush Specification, see [Create Brush Specification](#). It is also possible to modify the event positions by graphically selecting & moving the event marker.

Navigating Painting PowerPac

4.1 Painting PowerPac

The graphical user interface of Painting PowerPac contains two main parts as shown in the following picture:

- Painting Ribbon tab
- Painting Browser tab



4.2 The Painting Ribbon Tab

The Painting ribbon options enable the user to perform most Painting related operations.



The Painting Ribbon consists of 8 groups which are ordered in a sequence which the user would follow while creating a paint program.

- Paint Cell
- Paint Program
- Programming
- Synchronize
- Brush Table
- Job Control
- Virtual Fluid Device
- Show / Hide
- General Help

Group	Button	Description
Paint Cell	Import Workpiece	Opens a dialog where user can choose the CAD model which is then imported into the station and placed below the TCP of the robot.
	Brush Specification	Opens a dialog where users can Create Brush specifications to be used in a program.
	Preferences	Opens a dialog where user can create templates which are used when creating PaintStrokes.
Paint Program	New	Opens a dialog from where user can create a new paint program and select the Workpiece and the Brush Specification for that program.
	Load	Opens a dialog where the user can Load an existing Paint program.
	Properties	Opens a dialog where user can change the properties such as Name of the paint program, Brush specification and workpiece.
Programming	Create Manual Paint Stroke	Dialog where the user can teach Paint instructions on the workpiece.

Synchronize	Synchronize to VC	Dialog where user can select the procedures to be synchronized to VC
	Synchronize to Station	Dialog where user can select the procedures to be synchronized to the Station
Brush Table	Edit Brush Table	Opens a dialog where user can create Brush tables or connect to the <i>Virtual Applicator service</i> and get Brush tables and visualize the Spray pattern for a given brush number.
Job Control	Job Queue	Opens a dialog where user can Append jobs and visualize the production as it happens in the real paint system
	Virtual CBS	Opens a dialog where user can modify the parameters that are associated with the CBS system.
Virtual Fluid Device	Gun-On time and Material Consumption	Opens a dialog where user can select the Controller and view the Gun-On time and Material consumption parameters for different programs and materials
Show / Hide	Path and parts	User can Show / Hide Paths, Targets, Parts & Grid
General Help	About	Provides information about the product version and Support Contact information
	Contents	Opens the Online Help manual

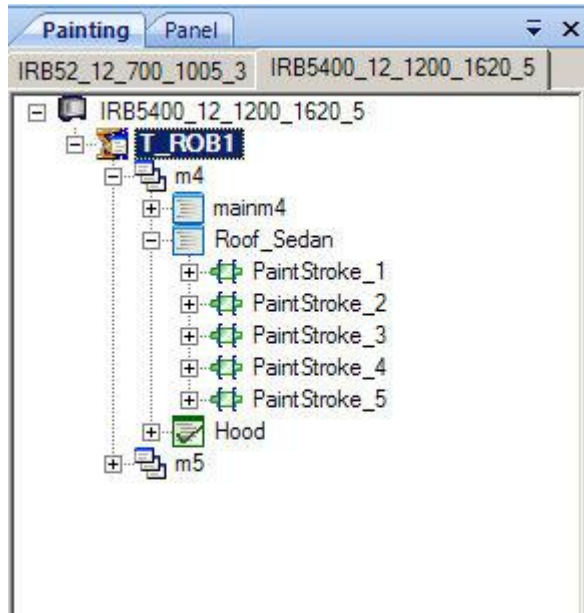
4.3 The Browser Tab

The Browser window in the Painting PowerPac provides a tree view of the System and the Paint programs that are created using the Painting PowerPac.

The workpieces are listed separately in another Browser window called *Panel*.

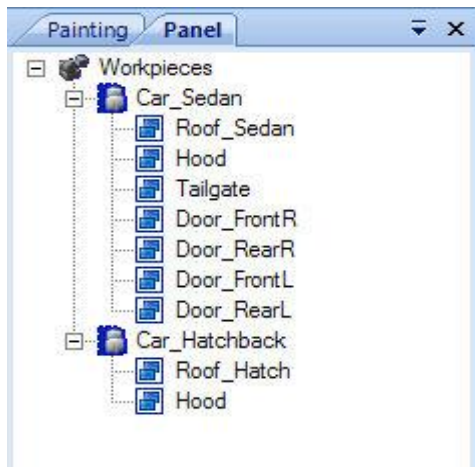
Painting

All the controllers in the station are listed in the Painting browser as separate tabs.



Panel

Panel browser window lists all the workpieces on which the paintstrokes are created. *Panel* represents a unique region on the workpiece on which the paint path has to be generated. Panels are identified and listed for each workpiece as shown below.



Workflow for Painting PowerPac

5.1 Workflow for Painting PowerPac

The following is a recommended flow for working with Painting PowerPac.

The Painting station must be setup in RobotStudio before activating Painting PowerPac. The Painting PowerPac provides a method for creating paths and events. Use the regular RobotStudio functions for building a paint station.

	Task	Description
1	Setup Paint Station	Create a new station from RobotStudio which has Paint systems. Import and attach paint tool libraries to the robot.
2	Activate Painting PowerPac and Import the Workpiece to be painted	When the workpiece is imported from the Painting PowerPac it is processed to be divided into smaller parts and listed under then Panel browser tree view of Painting PowerPac. You can identify a model as a workpiece either from outside or from an already existing one in the station. See How to Import workpiece
3	Identify Panels	On the workpieces identify <i>Panel</i> /which represents unique parts of the whole workpiece. Ex. Door, Hood etc. See Process Workpiece and Create Panels
4	Create the Brush Specification	The Brush specification contains information about the Width, Length, Color, TCP Speed, Pitch and Spray distance for each Brush number. See How to create a Brush Specification
5	Create New Paint Program or Load an existing program	User can create a new program after selecting the workpiece to the painted and the Brush Specification to be used in the program See How to Create a Program and How to load existing Paint programs
6	Create/Modify templates for the PaintStrokes	Use the "Preferences" tab to create templates with values for the Paint parameters and the Auto Paintstroke generation parameters. See How to create User Preferences

7	Create Brush Tables manually or by using Virtual Applicator service.	Brush Tables are required to calculate the parameters from Virtual Fluid Device See Brush Tables and Virtual Applicator
8	Create PaintStrokes using either <i>Create Manual PaintStrokes</i> or <i>Auto PaintStrokes</i> functionality	Teach the paint program on the workpiece. See How to create PaintStrokes and How to create Auto PaintStrokes
9	Synchronize to Virtual Controller	After creating PaintStrokes, Sync to VC from Painting tab.
10	Setup Simulation	Use <i>Job Queue</i> feature to setup production sequence by appending jobs or use RobotStudio Simulation setup and Start the simulation. See Job Queue
11	Check the Parameters from the Virtual Fluid Device	Check the <i>Gun-On time</i> and the <i>Material consumption</i> from the Virtual Fluid Device See Virtual Fluid Device
12	Use the context menu options to make modifications	User can modify the PaintStrokes and instructions and the Processed workpieces See Paint Browser options

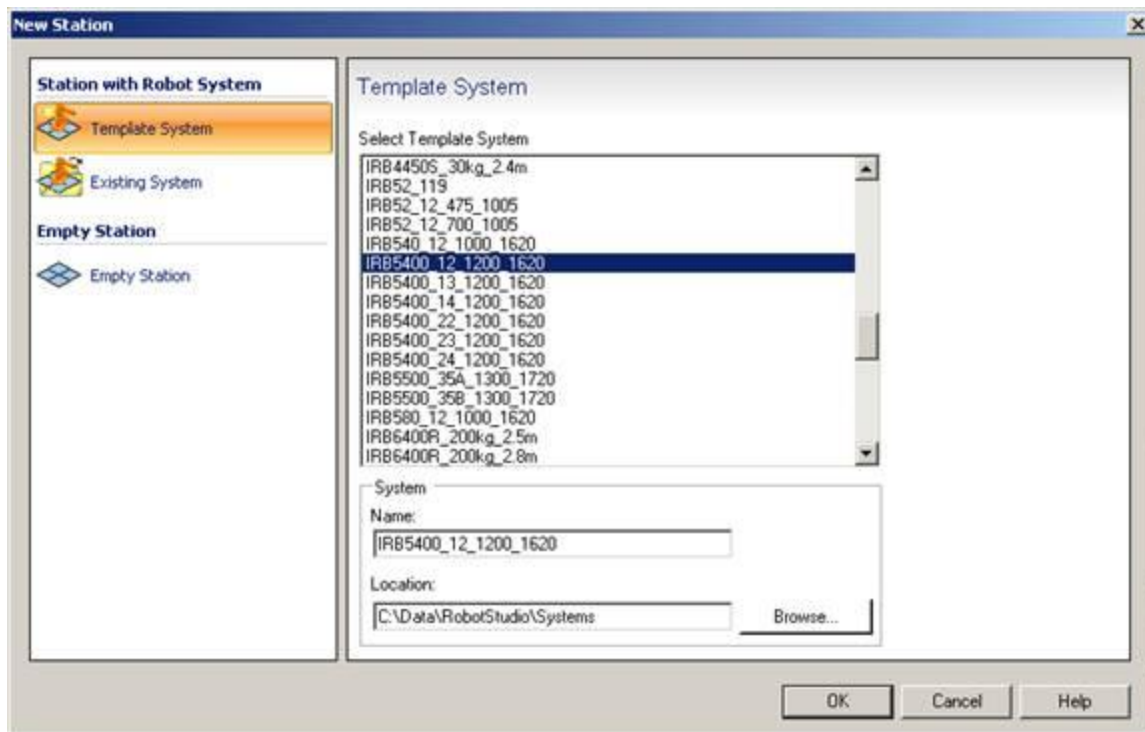
5.2 How to Create a Paint Station

Overview

This section describes how to create a new Paint station in RobotStudio.

Workflow

Click to Create a "New Station" and from Templates systems select one of the painting robot system & click OK. System would get loaded and appear in the RobotStudio browser.



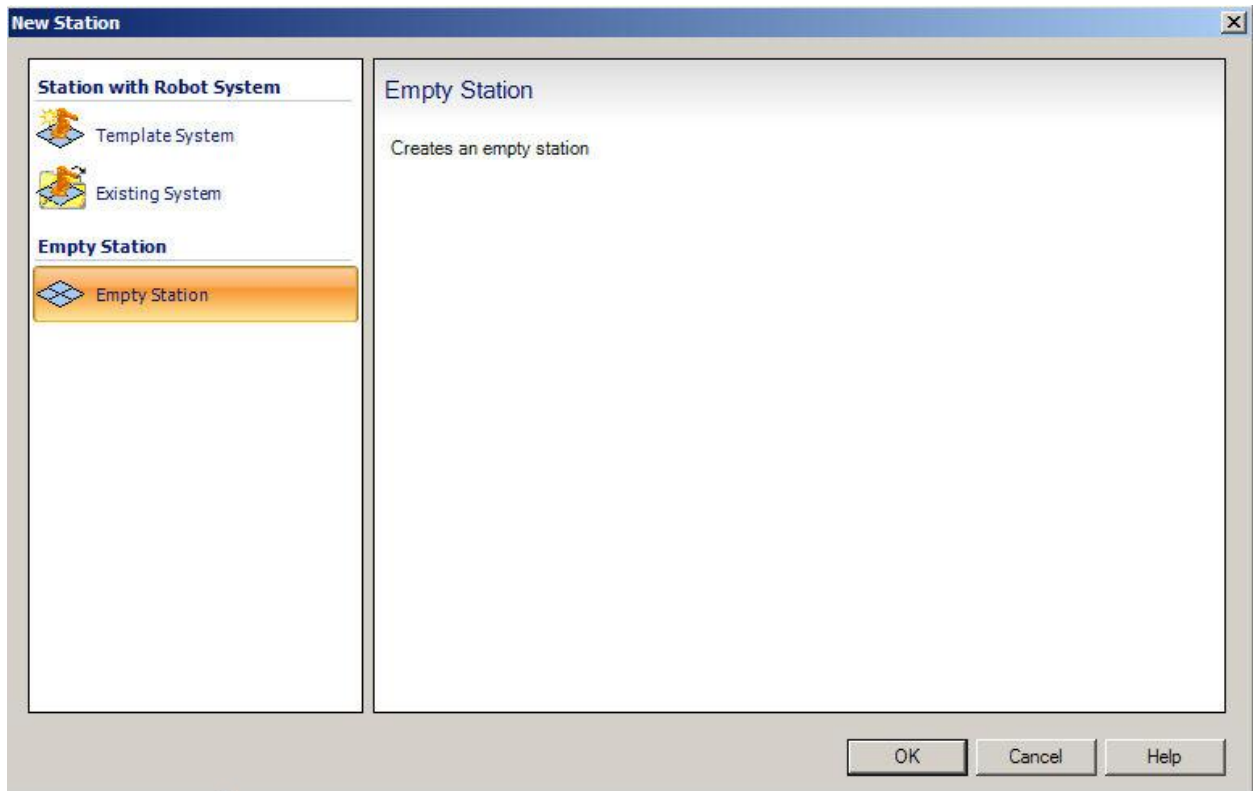
The Base frame of the Robot is rotated by 90 degrees as the Paint systems in RobotStudio are configured as right-sided.

It is also possible to create a new station from the Existing system. Create a system using the System builder in the *Offline* ribbon tab (using Virtual or Real) keys.

Color Change and CBS Options

Paint systems in RobotStudio will not have the options *Color Change* or *CBS* option selected by default. These options are required to be selected in order for user to simulate Material change and CBS operations. One method to select these options for the system is described below.

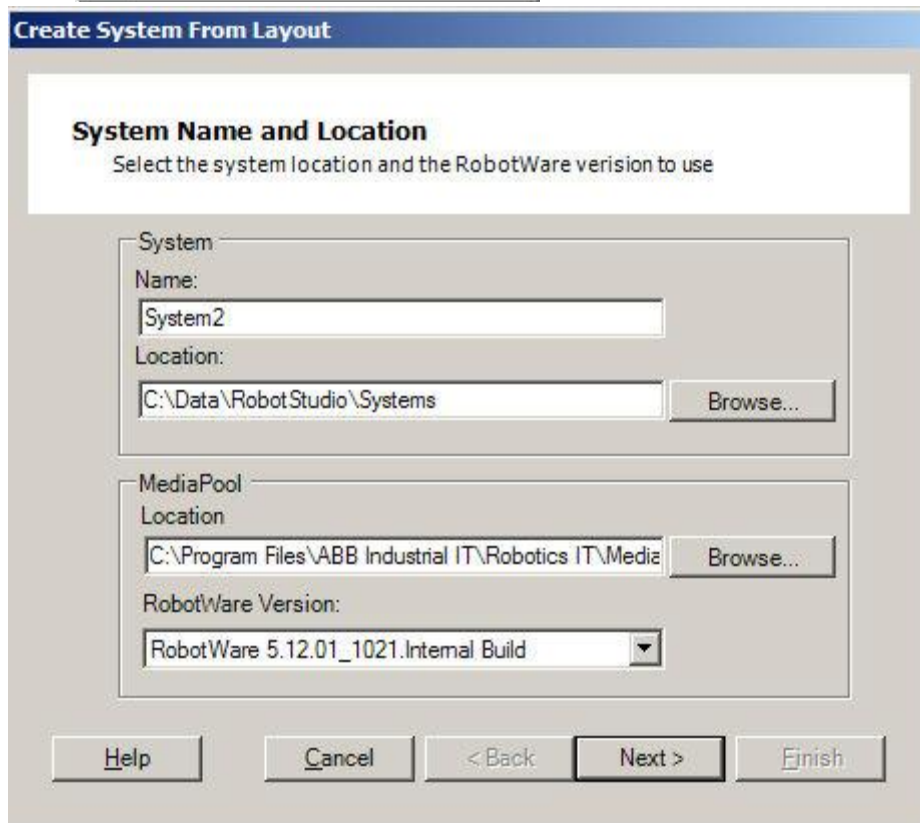
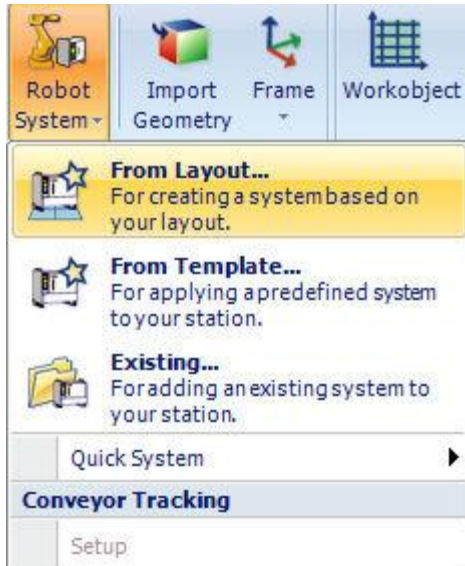
1. Create an empty station



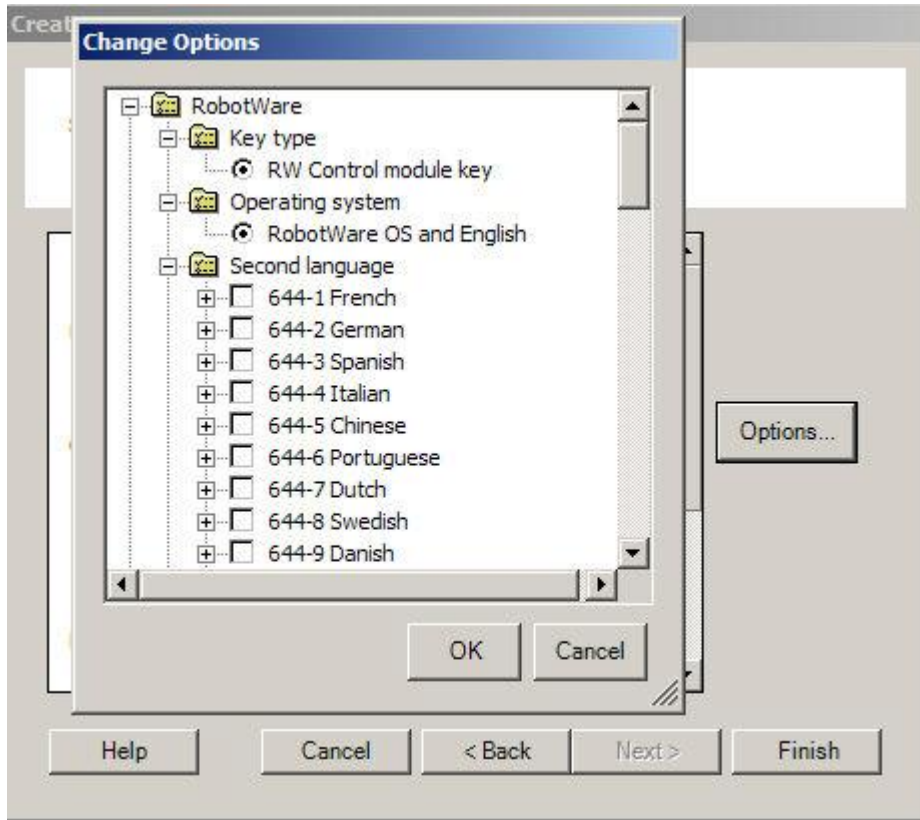
2. Import Paint libraries



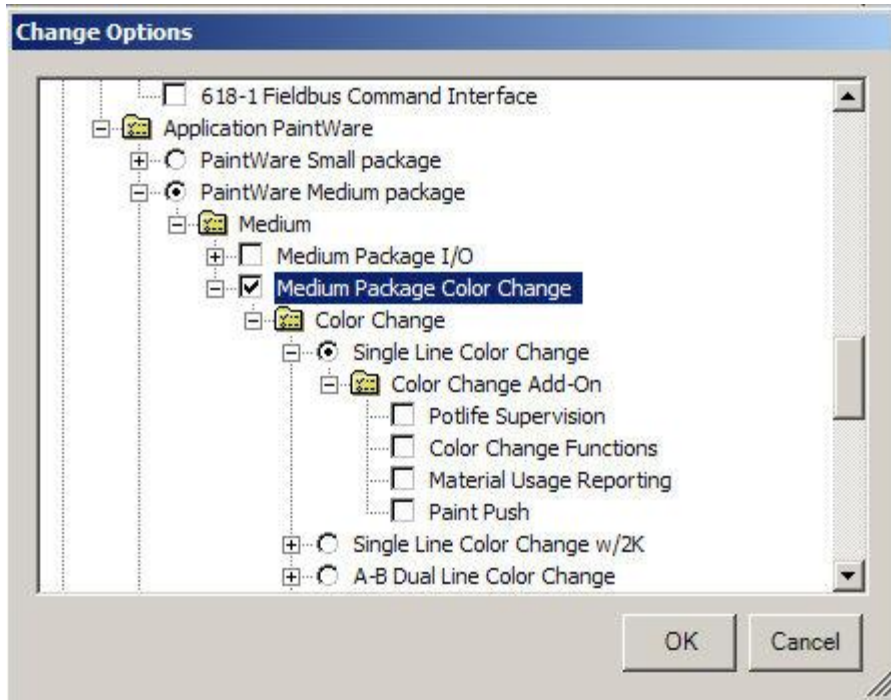
3. Create System from Layout and select the



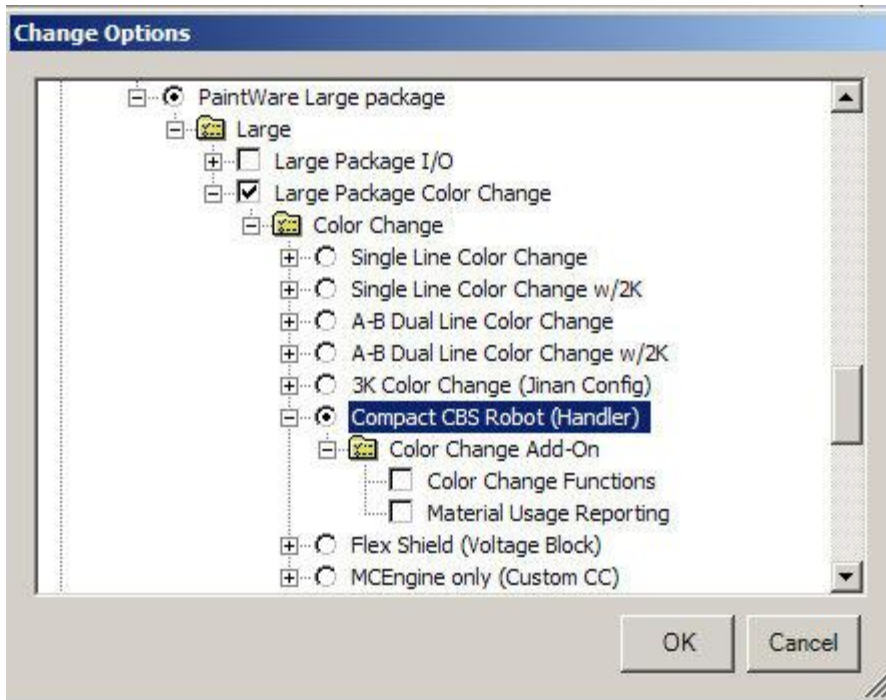
4. Select the Options



5. Select Color change from either Paintware Small or Medium or Large package



6. To create a system with CBS support, select the option "Compact CBS Robot (Handler)" from Paintware Large package

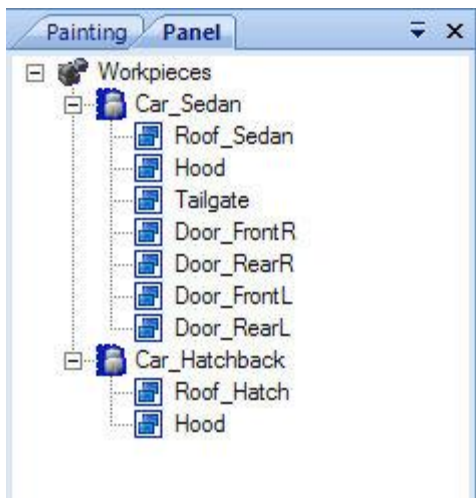


Whenever user selects any of these options, the corresponding options get enabled, see [Virtual CBS](#) and [Job Queue](#)

5.3 Import Workpiece

In a RobotStudio station, there can be several CAD models, some represent the part being worked upon and others the environment. The CAD models on which the paint programs are created are referred to as *Workpieces*.

User can import the workpiece CAD model from paint PowerPac. It is required that user imports the workpiece into Painting PowerPac tab to use path generation features.

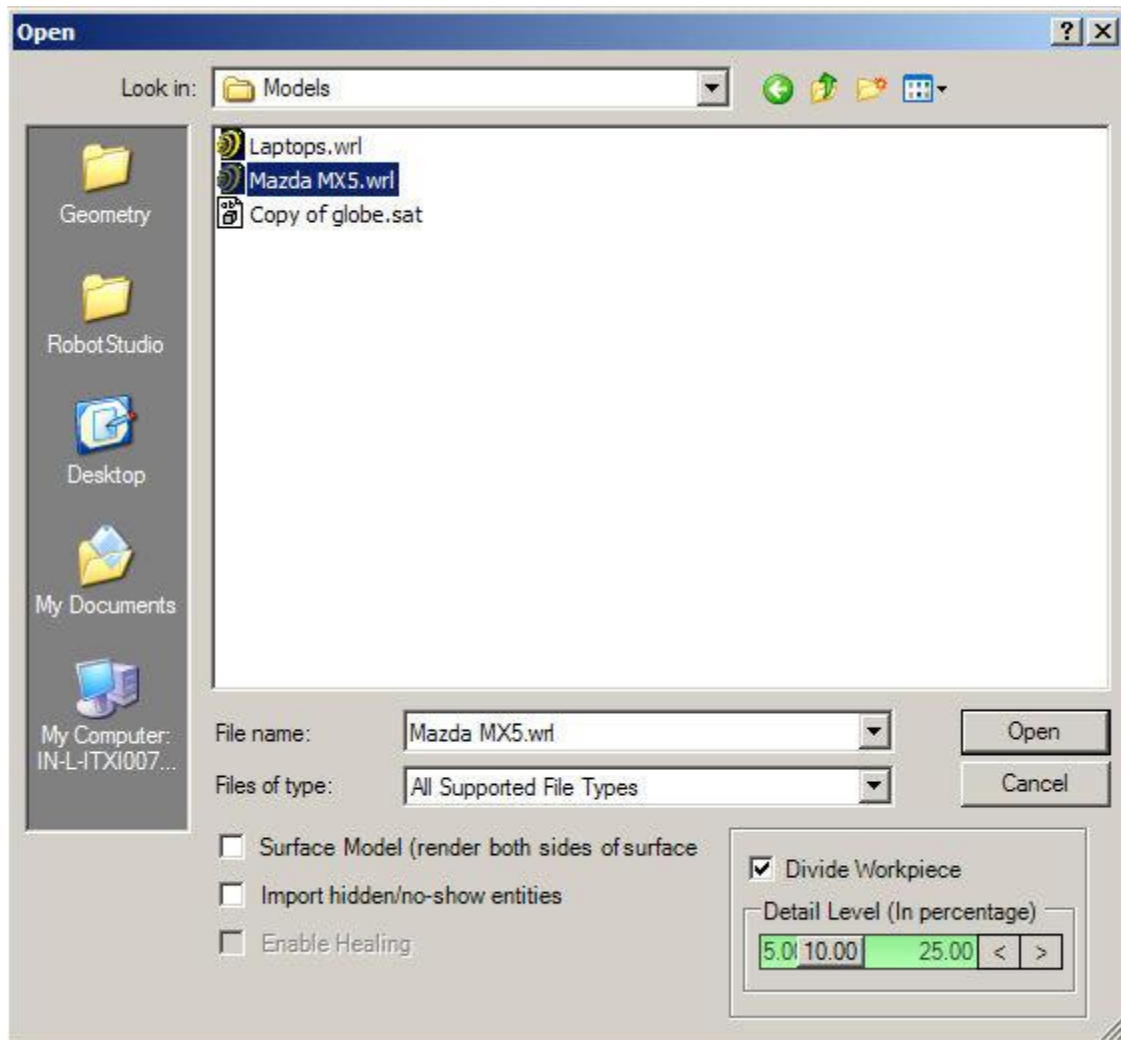


User can bring a workpiece into Paint PowerPac using two options

1. Browse for the workpiece CAD model from folder
2. Select an existing workpiece CAD model in the station

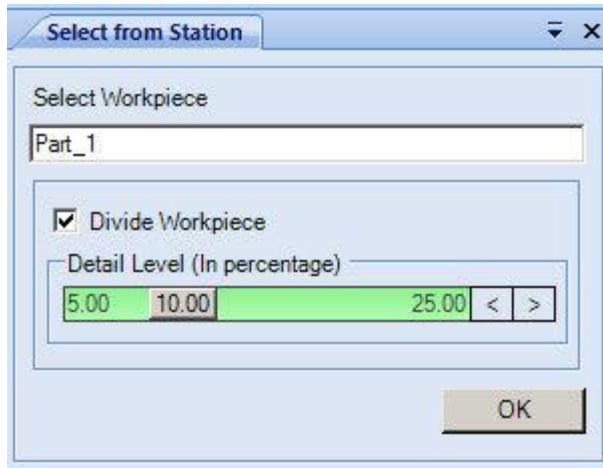
Browse

User can divide the workpiece into smaller parts after selecting the level of detail by which the parts will be filtered.

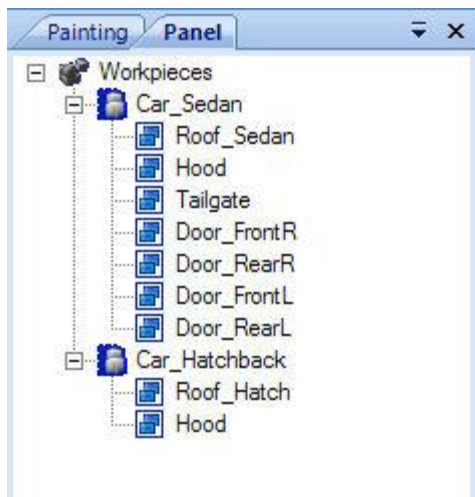


Select from Station

It is possible for user to identify already existing CAD models in the station as Workpieces and bring them into paint PowerPac.



Whenever a workpiece is imported into Paint PowerPac, it is listed in the Panel browser tab as shown below.



The workpieces imported into PowerPac are stored as a Graphical Component Group (GCG) in RobotStudio.

On these workpieces user can perform a number of operations as shown in [Panel browser options](#).

Divide Workpiece

The workpiece imported could have varying levels of detail and information and could be in any of the formats that are supported by RobotStudio. When importing a workpiece into paint, user can divide it such that it is easy to identify *Panels* (Panels are pre-requisites for auto path generation) to create paint strokes.

If the workpiece is well defined and structured in the sense that contains enough information to identify *Panels*, it might not necessary for user to divide the workpiece in order to identify panels. However it is possible user to divide workpiece even after importing using several options as described below

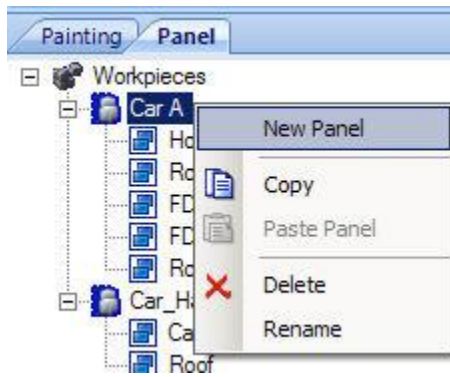
1. Split using one of three options
2. Use "Select from station" on the workpiece again.

The Split option is described in detail in [Process Workpiece and Split Panel](#).

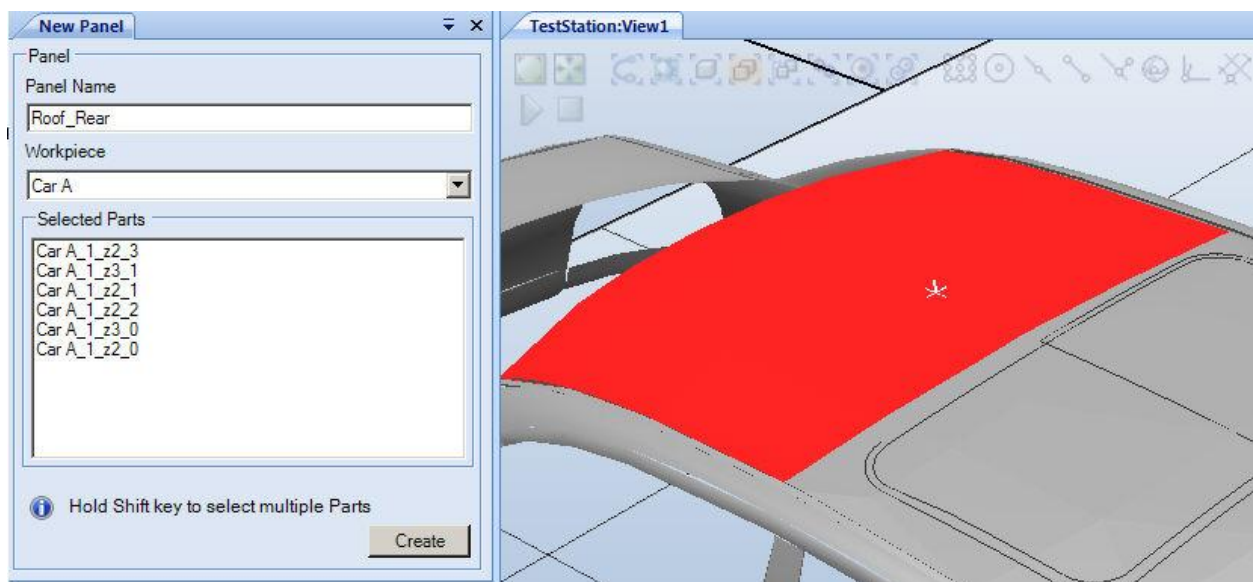
5.4 Create Panel

A Panel on a workpiece is a collection parts that identify individual sections on the workpiece. For example on a car workpiece, the panels could be the Hood, Doors, and Tailgate etc.

The feature is launched upon clicking the Create Panels option under Process Workpiece ribbon tab or by right-click option on the Workpiece listed under Panel browser window.

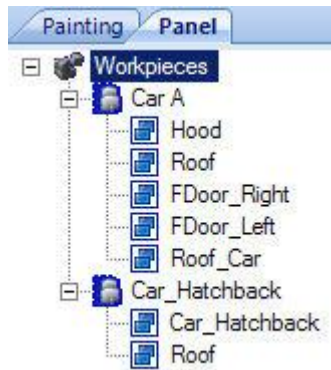


This launches a dialog as shown below. Click on the parts on the workpiece



The usage of this functionality is as below

	Task	Description
1	Verify the name of the Panel	By default a name will be suggested which will be Panel_1, Panel_2 etc. User can also specify the name of the Panel as desired. Ex: Hood, Door etc.
2	Select the workpiece	Only workpieces which are listed under Panel browser window will be listed. User must choose the corresponding workpiece with which the Panel has to be identified.
3	Click to select the parts	Click on the surface of the workpiece to select the parts. The selected parts will be listed in the dialog.
4	Click on <i>Create</i> button	The panel is created and listed in the Panel Browser window below the corresponding workpiece selected in step 2.



User can perform operations on the Panel such as

- Generate Path - Opens the AutoPaintstroke dialog
- Edit Panel - User can edit the panel to add or remove parts
- Split Panel - User can split a Panel using
 1. Cutting planes
 2. Freehand
 3. Select bodies

More information on each of these options is covered under Process workpiece

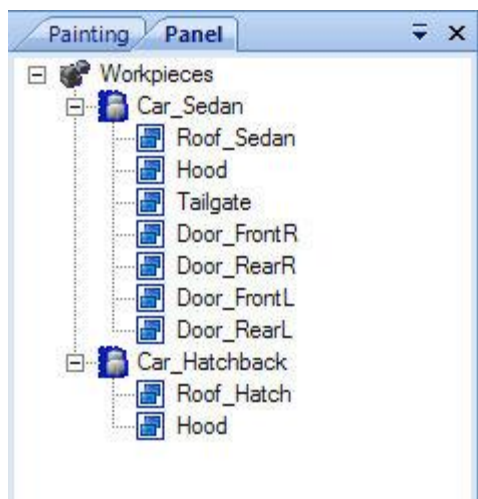
- Copy / Paste - Copies a Panel
- Rename
- Delete

5.5 Panel browser tab

The workpieces are listed in the Panel browser tab. The Panel browser tab is organized as

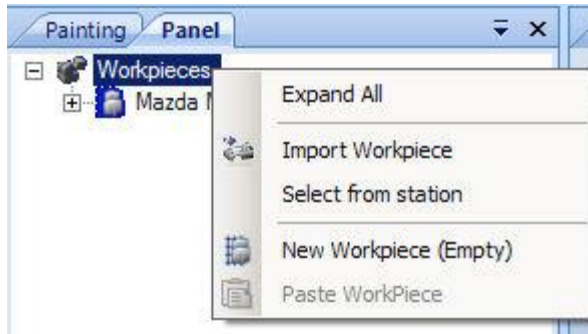
Workpieces

- Workpiece_1
 - Panel_1
 - Panel_2
 - Panel_3
 - Panel_4
- Workpiece_2
 - Panel_1
 - Panel_2
 - Panel_3
 - Panel_4
- Workpiece_2
 - Panel_1
 - Panel_2



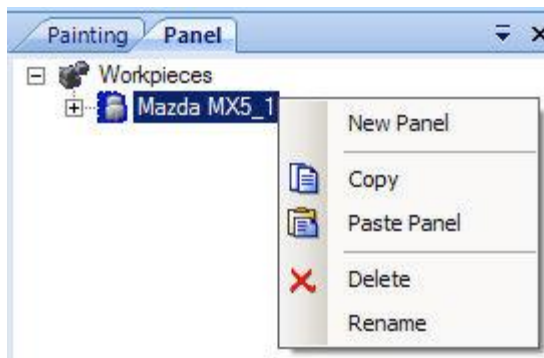
User can perform a number of operations on the panel tree nodes as described below

Context menu options from 'Workpieces' node



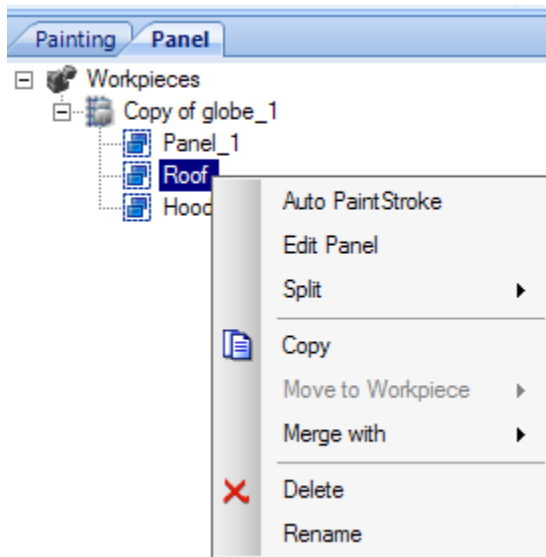
	Option	Description
1	Expand all	Shows all the Panels listed under all the workpieces.
2	Import Workpiece	Opens the dialog where user can import the workpiece by browsing the folder.
3	Select from station	Opens the dialog where user can select graphically a CAD model to be imported.
4	New Workpiece (Empty)	A new blank workpiece is created and listed in the tree view. User can drag & drop or Copy/paste Panels from other workpieces into the new workpiece. The workpiece such created is a Graphic Component Group in RobotStudio.
5	Paste Workpiece	User can Paste a copied workpiece. A new node will be created under <i>Workpieces</i> node. A copy of the corresponding parts of the Panels is created in the workpiece graphic component group.

Context menu options from 'Workpiece' node



	Option	Description
1	New Panel	Opens dialog where user can select Parts to create Panel
2	Copy	Copies the Workpiece and all the panels under it
3	Paste Panel	Creates a new Panel under the workpiece. No new parts are created under the workpiece.
4	Delete Panel	Deletes the Panel only.
5	Rename	User can rename a workpiece. The corresponding Graphic component group is also renamed in RobotStudio.

Context menu options from 'Panel' node



	Option	Description
1	Auto PaintStroke	Opens the AutoPaintstroke dialog
2	Edit Panel	User can edit the panel to add or remove parts
3	Split	User can Split a Panel using <ul style="list-style-type: none"> 1. Cutting planes 2. Freehand 3. Select bodies More details are explained in Process Workpiece
4	Copy	Copies the parts in the Panel in the workpiece

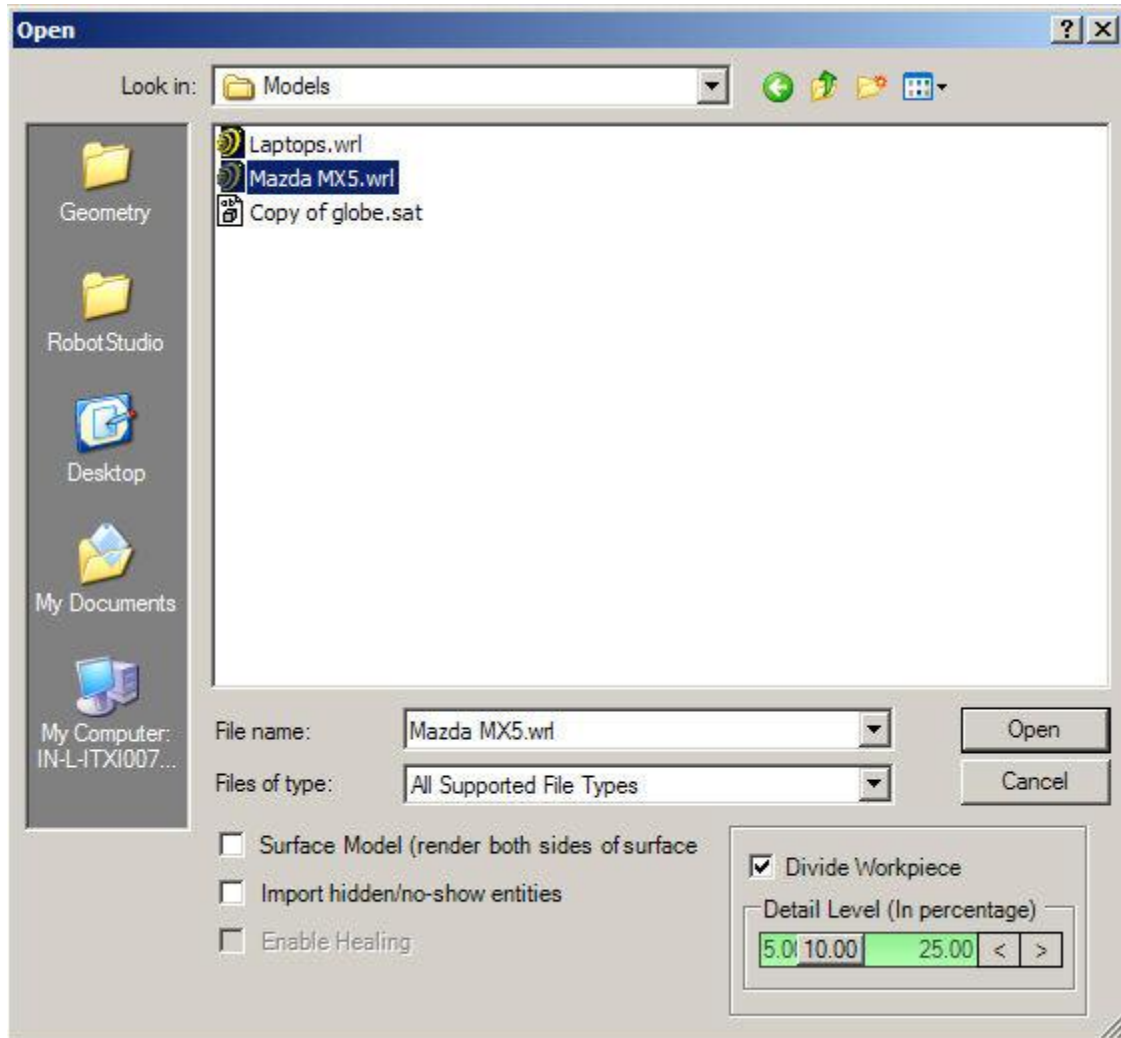
5	Move to Workpiece	The parts in the Panel are moved to the selected workpiece.
6	Merge with	Lists all the Panels in the selected workpiece. After the merge operation the source panel is removed.
7	Rename	User can rename a Panel, note that the Panel naming conventions follow the RAPID procedure naming conventions.

NOTE! *Copy-Paste*, *Move to Workpiece* and *Merge with* operations can also be performed by using Drag & Drop operations on the Panels as described below

- Merge with - Select Panel and drag and drop onto another Panel in the same workpiece.
- Move to Workpiece - Select Panel and drag and drop onto another workpiece in the Panel tab.
- Copy-Paste - Select Panel, Hold Shift-key and drag and drop onto another workpiece.

5.6 Process Workpiece and Split Panel

Import workpiece provides options for user to *divide* or break down into smaller parts.

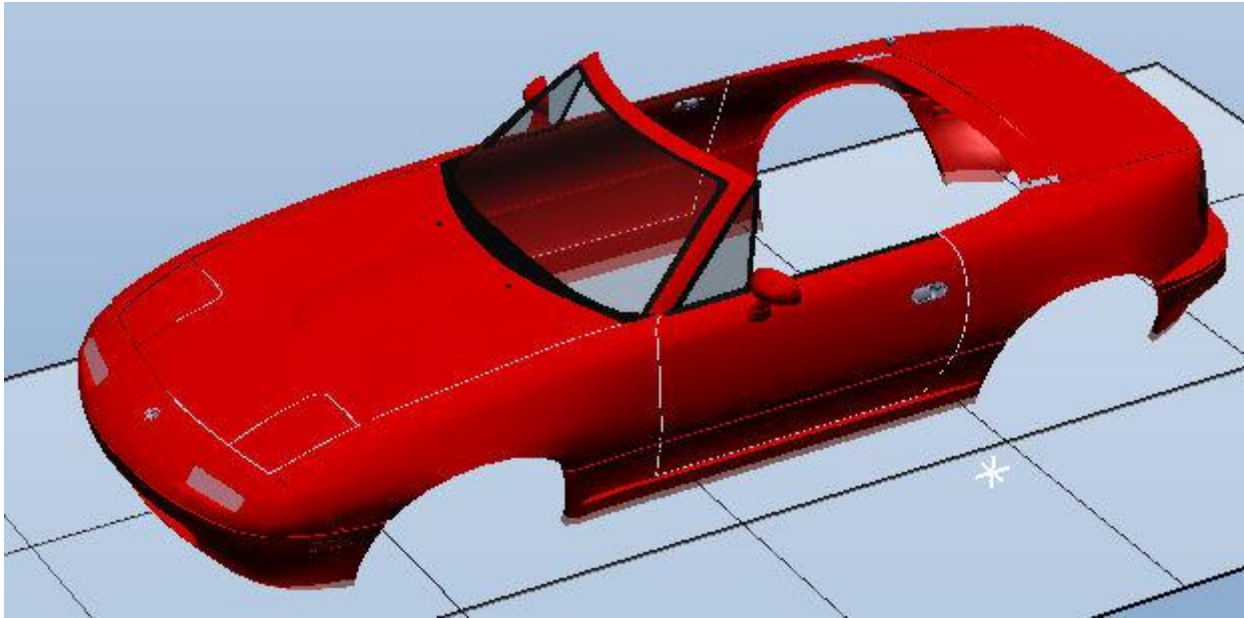


Description

	Task	Description
1	Select the workpiece by either Browse or Select from station	Workpiece name is reflected in the dialog
2	Check for the Filter size. By default the value is 10% of the Workpiece size.	By defining a filter size, user can set the smallest size of the divided parts. After subdividing, any part which is smaller than the filter size will be deleted. It shall be possible to change the filter size as a Percentage value of the size of the workpiece.
3	Select to Import	The workpiece will be imported into RobotStudio and then subdivided into smaller Triangular parts.

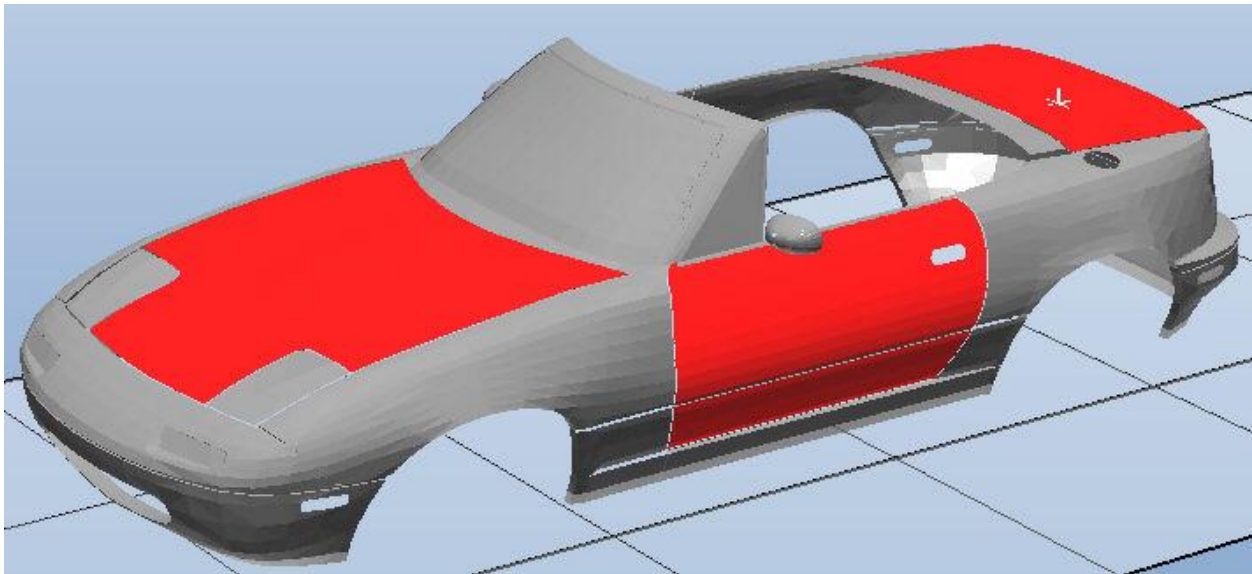
1. Divide Workpiece

A model can be divided into smaller parts based on the natural gaps in the model. If the imported workpiece is a single part as shown below, then the process identifies natural gaps in the model such as the Door, Hood and the Head lamp etc. and sub-divides the model into smaller parts such that the natural gaps are clearly identified.



Original Workpiece

The below image shows the workpiece after it has been sub-divided into smaller triangular parts. The individual parts corresponding to the Door, Bonnet etc. can be identified individually.



Divided Workpiece

Processing a workpiece to sub-divide into a number of smaller parts depends on the format, size, complexity and the level of detailing in the model. If the model is highly detailed and of large size, then the process will take more time to complete. This functionality requires a minimum free main memory size of 500 MB.

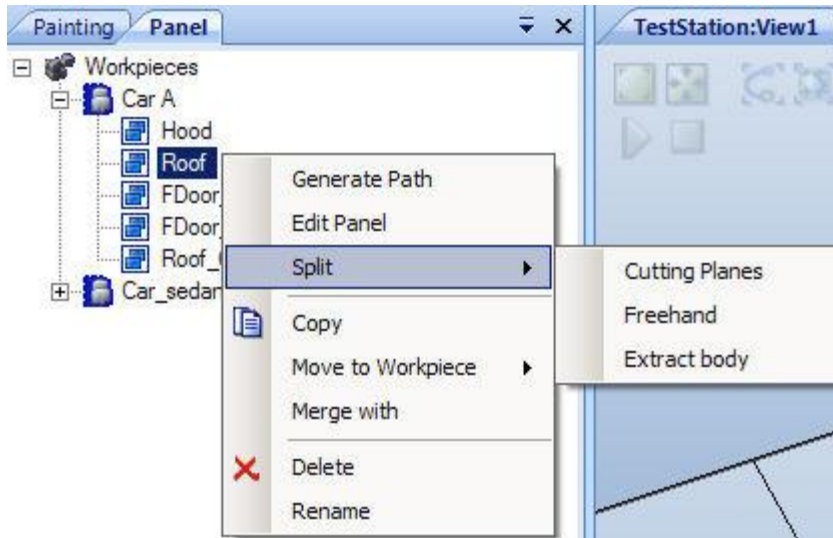
The imported workpiece is listed in the Panel browser tab and the divided parts are all collected together as a Panel.

2. Split Panel

Panel represents a collection of logically connected parts which represent a unique section of the workpiece, for example Hood, Door etc. of a car body. In Painting PowerPac, it is possible to split a panel into two or more panels such that a program can be generated for each panel separately. Split operation mostly divides / creates parts and identifies the collection of parts uniquely as Panels.

Some scenarios but not limited to when user is required to Split a panel are

- When using multiple robots to Paint (painting car panels), it is required to identify the painting region for each robot. User can Split the panel into sub-panels and create programs for each robot separately.
- If a workpiece is well defined i.e., when importing into Paint, user may choose not to divide. User can Split the workpiece panel based on the information in the workpiece.



Split operation can be done

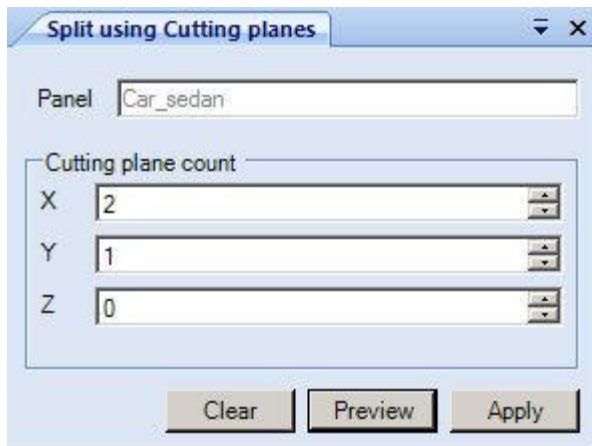
- using Cutting Planes
- on Freehand
- Extracting bodies

- **Split using Cutting Planes**

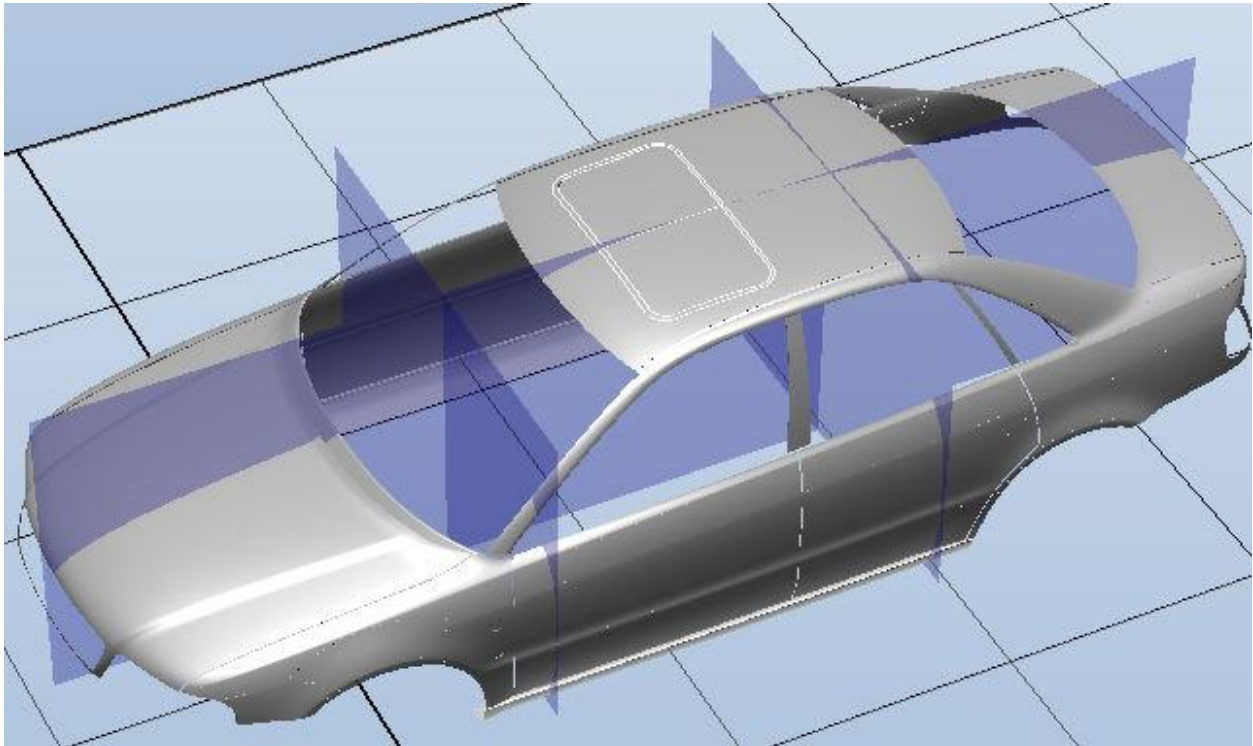
This functionality divides a Panel along a number of cutting planes which intersect the parts along each axis. The cutting planes are placed such that the workpiece is divided equally into the number of planes along each axis.



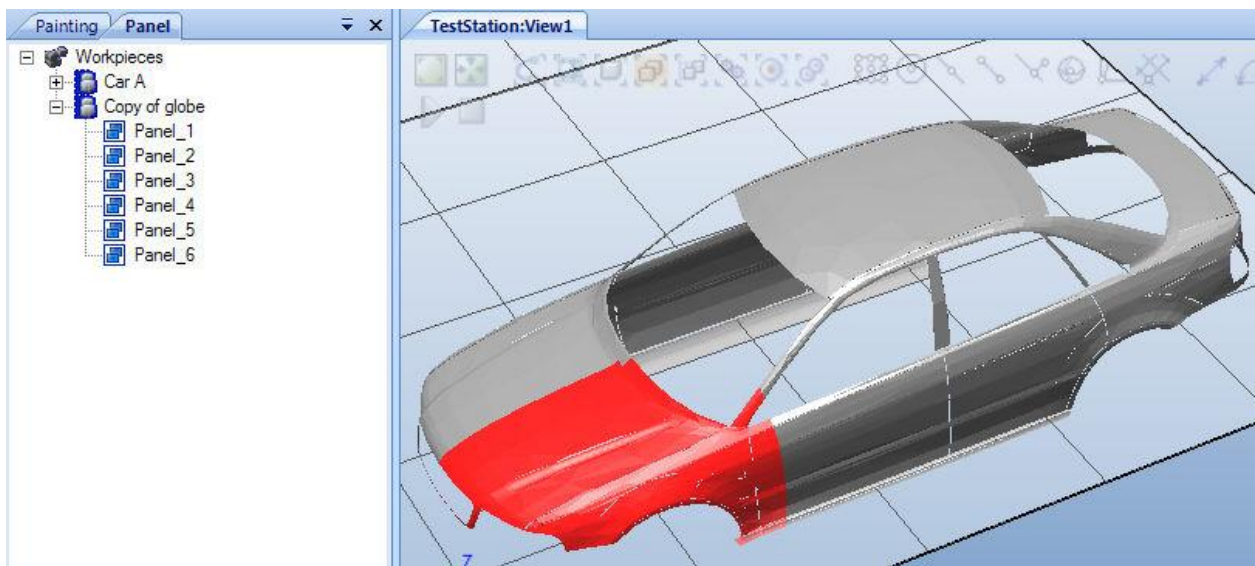
This Panel is split with the following selections. The X, Y & Z axis represent the Panel.



Clicking on *Preview* shows the cutting planes on the Panel as below.



When user clicks on *Apply*, the parts in the panel are divided along these cutting planes and the parts within each plane are identified as a Panel, i.e. in this case, there are 6 panels created.

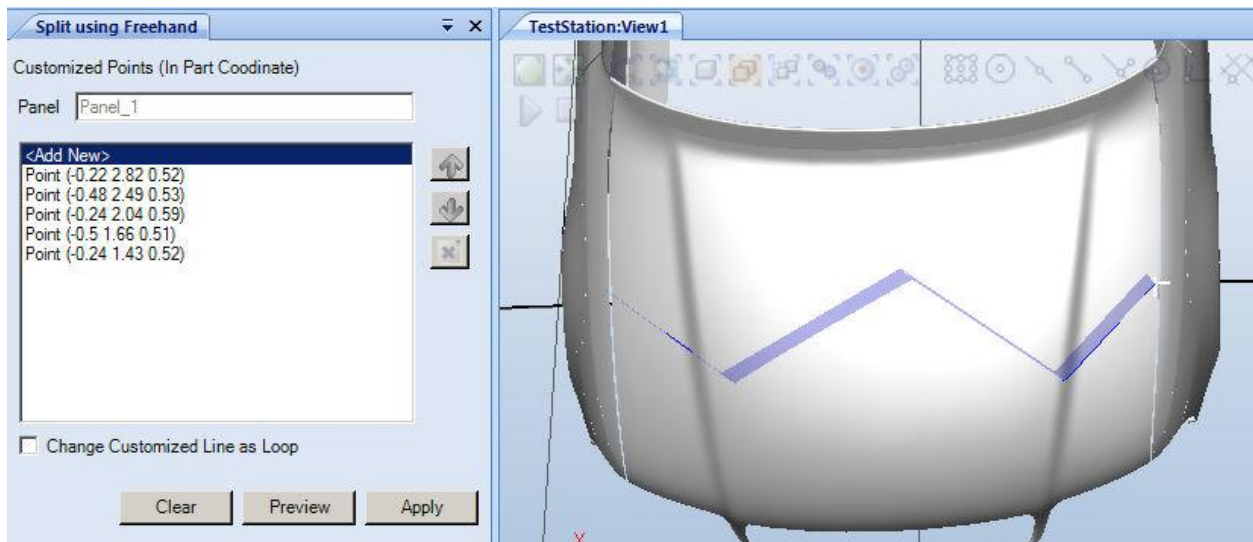


Dividing a workpiece during importing breaks it into smaller parts along the natural gaps in the surface. Hence it may not always identify one half of the car body by selecting parts. In this scenario the functionality of being able to Split an existing Panel helps user to identify different Panels along different sections uniquely.

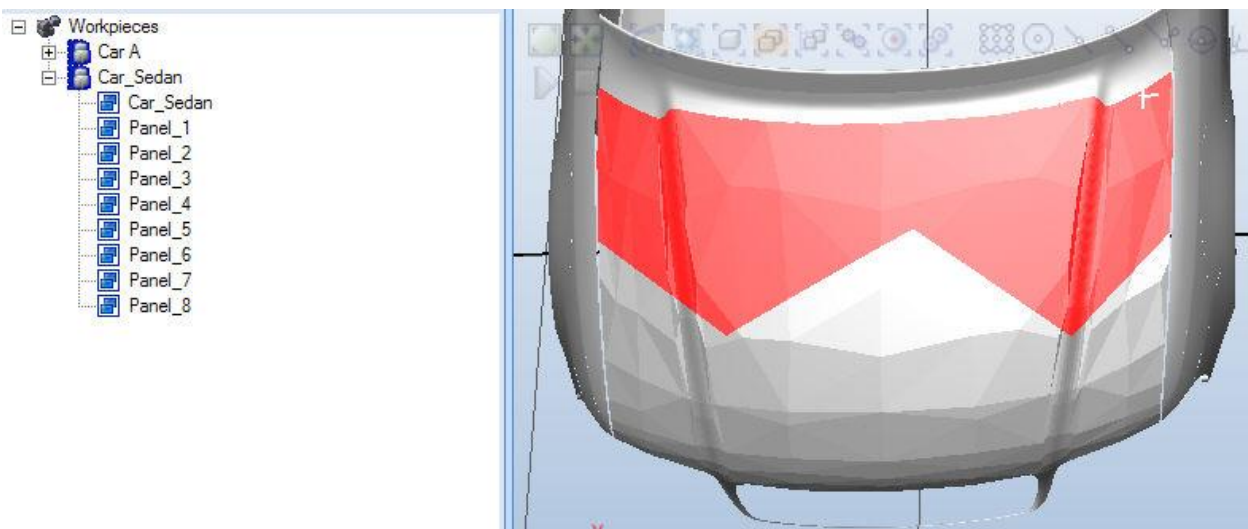
User can customize the cutting planes' position using RobotStudio options Freehand Move / Rotate.

- **Split using Freehand**

This functionality provides user the ability to split a panel along user defined direction.



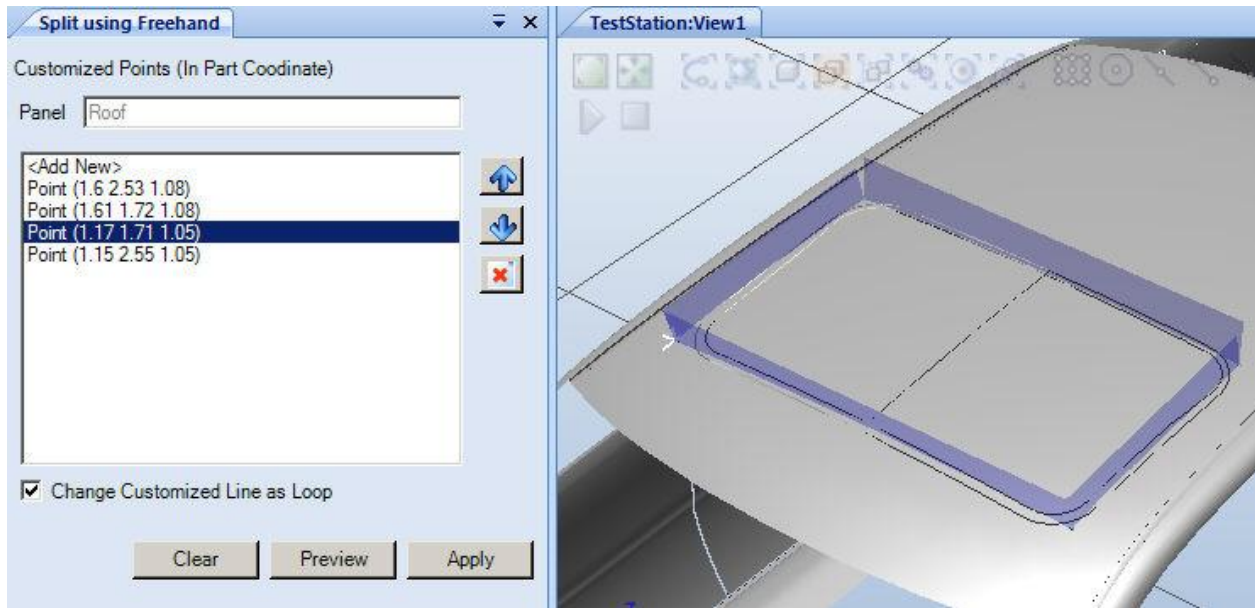
The above figure shows the Panel of Hood of a car where user has clicked to select 4 points on it. When user chooses *Preview*, the cutting plane is generated along the line joining the points sequentially. When user clicks *Apply*, the parts in the panel are divided and identified as Panel/Panels along the cutting plane.



The Panel is divided into at least 2 panels. Depending on the Panels user can then *Merge* panels.

If user selects the check-box option *Change customized line as Loop*, the cutting plane created will form a closed loop by joining the first and last point as shown below.

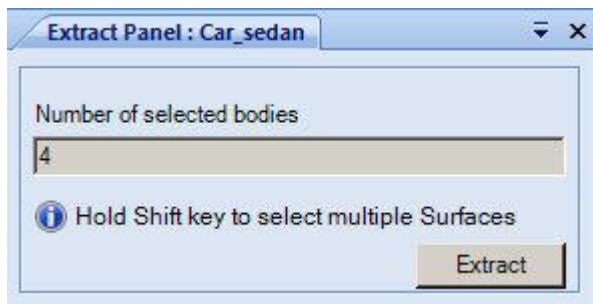
The cutting planes' points are created such that they represent the sun-roof of a car.



The arrows can be used to move the points up and down such that the sequence changes. User must click on Preview to re-generate the cutting planes.

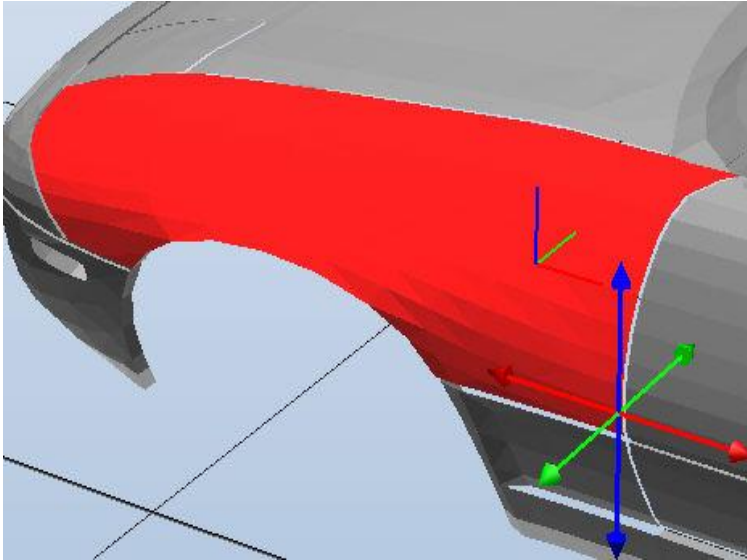
- **Extract body**

A Panel is a collection of parts. Using this functionality it is possible to Split the panel such that user can collect a number of bodies within the part and create a part from the collection. This part is then identified separately as a Panel.

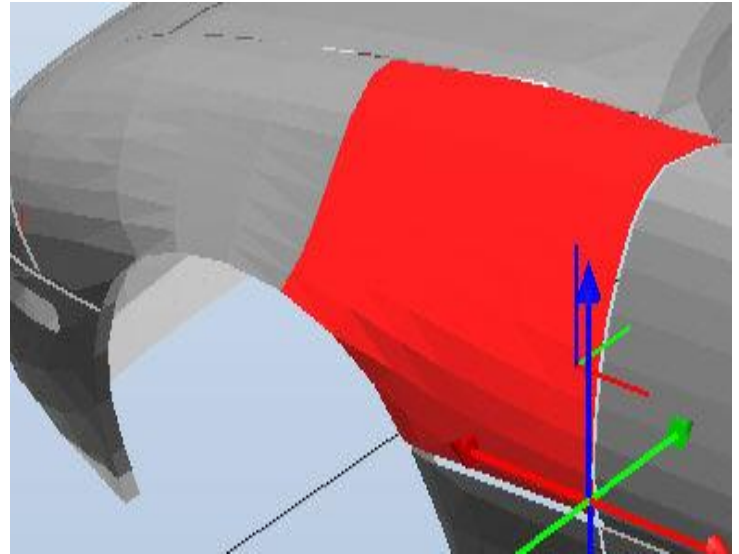


Workflow

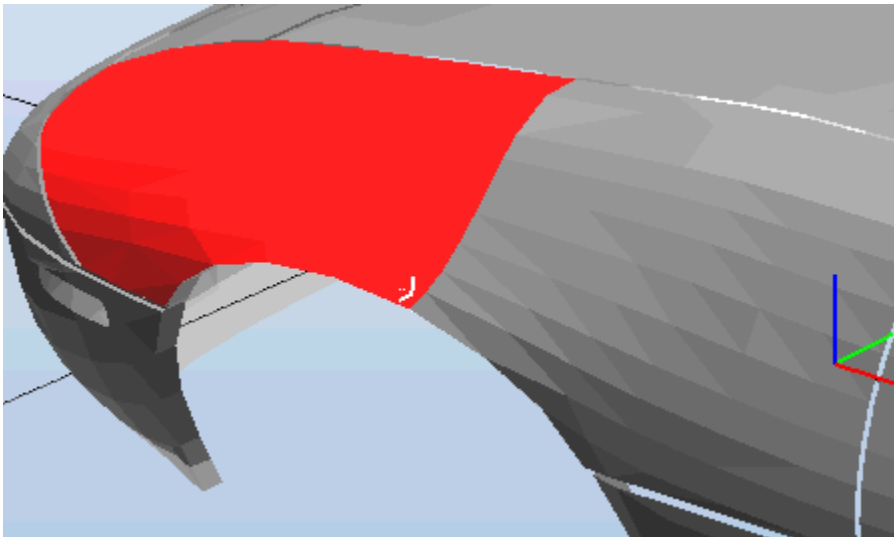
In the dialog box, click on the text box *Number of selected bodies*. The selection level then changes to *body*. User can click on individual bodies and then click on Extract. All the selected bodies will be grouped together as a separate part and listed under the Meshed workpiece. The new part is subsequently identified as a Panel.



Before extraction



After extraction (left side of the panel)



Separated part

This functionality is useful when user has a Panel which has

- Parts which have multiple bodies (after dividing)
- Parts with well defined geometries which user need not divide to identify Panels.

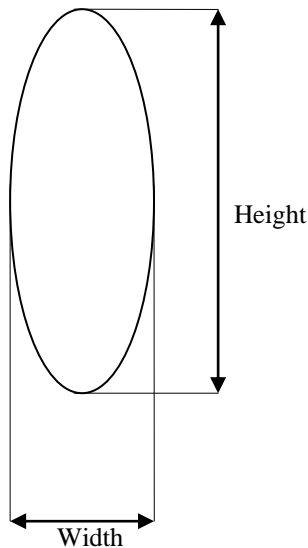
NOTE ! Split operation using Cutting planes & Freehand can be performed repeatedly. The time taken for each operation depends on the number of parts and bodies in the Panel. Hence it is important to note that the computer has sufficient free RAM memory (at least 500 MB) before proceeding with the operation.

5.7 Create Brush Specification

Brush Specification is a table of brush properties used by Painting PowerPac for displaying purposes as a supplement to the “standard” Brush Tables. These Brush properties are not used by the robot controller directly, but is used by Painting PowerPac to identify PaintStrokes and while accessing the Virtual Applicator service which supplies the appropriate Brush Table parameters. When user wants to create a Paint program, it is required to have a Brush specification defined in the station. Brush Specification contains information about the

- Width
- Height
- Color
- TCP Speed
- Pitch
- Spray Distance

for each Brush number. The width & height information is used when creating/identifying paint strokes. The color information in a Brush number is shown on the path. The width and height represent the pattern of the spray for the corresponding Brush number. A value of 0 for Width & Height indicates that the corresponding brush number is used to Turn-Off the paint. This information is used when Loading existing Paint programs. It is important to create the appropriate Brush specification such that the PaintStrokes are identified correctly.



Usage

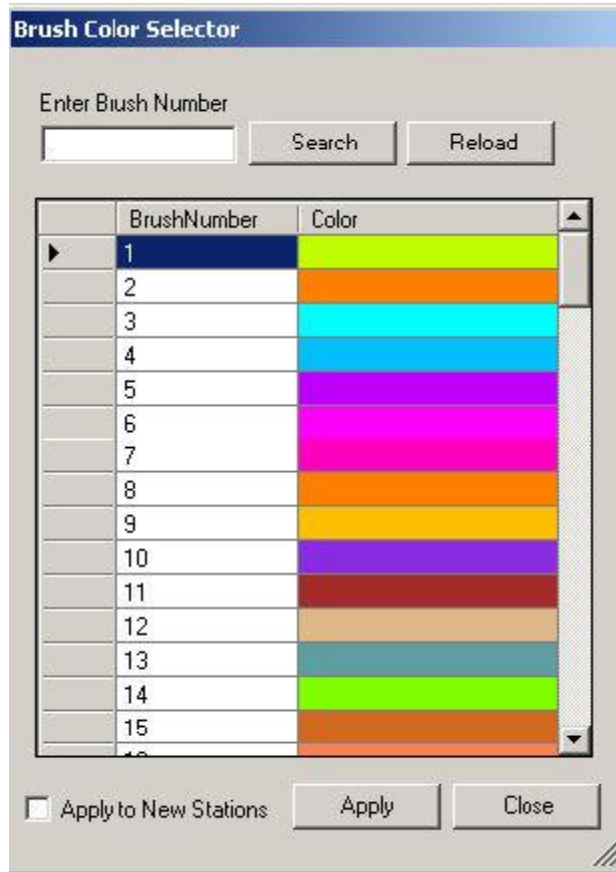
Click the “Brush Specification” Ribbon tab to get the form for creating a Brush Specification.

	Width [x mm]	Length [y mm]	Color	TCP Speed [mm/s]	Pitch [mm]	Spray Dist [mm]
▶ 1	0	0		v300	200	300
2	10	10		v300	200	300
*						

Steps to Create a Brush Specification

Item	Description
1 "New"	<p>Enter the name of the Specification ex. "Brush1" and click on "Apply". The name is appended in the list on the left side of the dialog.</p> <p>Multiple Brush Specifications can be created by following the same step.</p>
2 Specify Parameters	<p>"Width" & "Length" specify the 'X' & 'Y' (in mm) of the spray pattern. Some default values for Brush numbers 1 & 2 are appended automatically, user can change the values.</p> <p>The Pitch, Spray Distance, TCP Speed are used in the Virtual Applicator service which calculates the Brush Tables for the given values along with information from the <i>Paint Specification</i>.</p> <p>For any given program user must ensure that the above values used when making a Paint program by specifying them in the Preferences</p>

3	Save	When a new Brush Specification is created, it is automatically saved. If user enters/modifies the Brush number parameters, then user must click "Save".
4	Delete	User can delete the Brush Specification by clicking "Delete" after selecting from the tree view.
5	Color	Each Brush number has an associated Color. The color can be changed in the dialog as shown below.



Color of a Brush Number is the same for all the Brush Specifications defined in the Station. When user changes the color of any Brush number, then the changes are reflected graphically for all the events associated with that Brush number and for all the Brush Specifications in the Station. User can use the changed color information for all the subsequent Stations created by selecting the check box for *Apply to New Stations*.

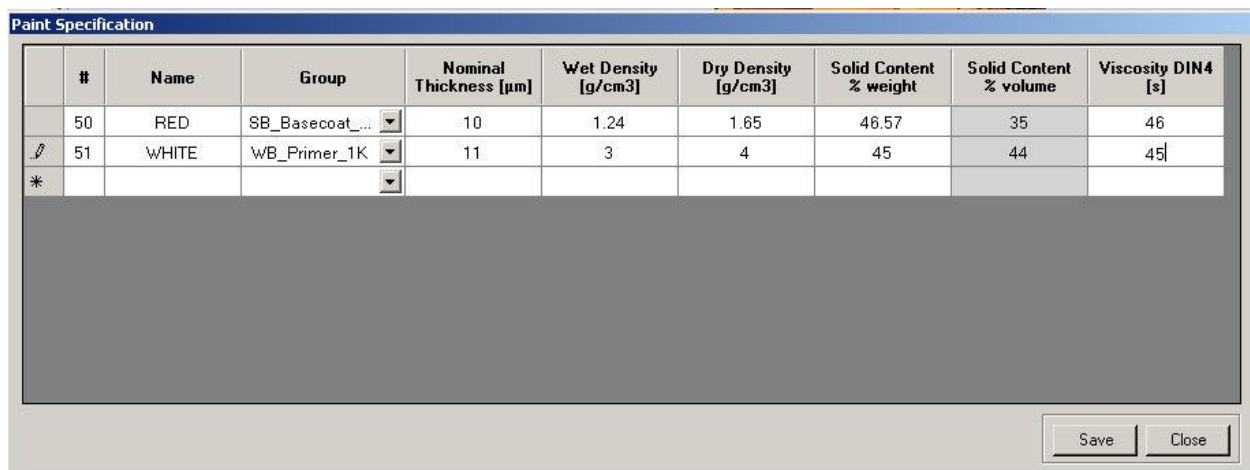
5.8 Create Paint Specification

This section describes the usage of the Paint specification that contains details of the paint material that are used during the painting sequence.

The option is launched when user selects the Paint Specification option from the Paint Cell group in the ribbon tab.



The dialog opens as below



Usage

User can define the Paint material parameters and characteristics in the Paint Specification. This information is used by the Virtual Applicator while calculating the Brush Table.

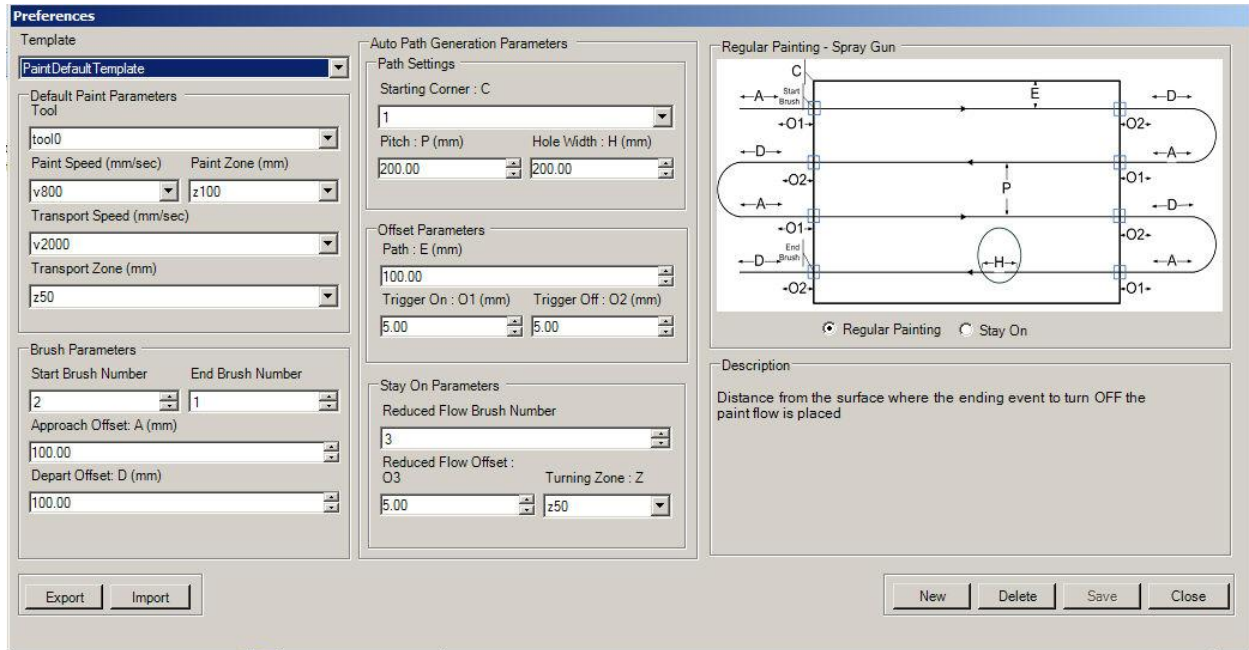
	Item	Description
1	Number	The Paint Number which will be used to identify the Paint type.
2	Name	The name of the paint/material. Ensure that the name of the material and the number are unique.

3	Groups	<p>If user has a license for Virtual Applicator, then user can select from the drop down menu a list of Paint groups which identify the nature of the Paint, i.e whether it is Water based (WB) or Solvent based (SB) and Primer coat or Base coat or Clear coat.</p> <p>If Virtual Applicator license is not installed, then the option None is listed.</p>
4	Wet and Dry Density	<p>Density of Paint in wet and dry mass conditions measured against the total volume of the paint sample.</p> <p>Unit - gm / cm³</p> <p>DataType - Double</p>
5	Solid Content % Weight	<p>Value measured in percentage is the ratio between the total amount by weight of all Solid ingredients and the total amount by weight of paint.</p> <p>DataType - Int</p>
6	Solid Content % Volume	<p>Value measured in percentage is the ratio between the total sum by volume of all Solid ingredients in paint and the total sum by volume of paint.</p> <p>This value is calculated when user enters the value for Solid content % weight and the Wet and Dry density.</p> <p>DataType - Int</p>
7	Viscosity	<p>Specify the viscosity of the Paint.</p> <p>Unit – CentiPoise</p> <p>DataType - Float</p>

5.9 How to create user Preferences

Information used when creating Paintstrokes are stored as user Preferences. Preferences are stored in a station in the form of Templates. User can define all the parameters that are associated with Paint and Brush instructions and those required when using the Auto path generation functionality.

Clicking on the Preferences button brings up the dialog as shown



Description

	Item	Description
1	Choose template	All templates that are created are listed. The user can choose any one and the corresponding values are selected for the options. A default template by the name <i>PaintDefaultTemplate</i> is created for every new station
2	Painting Parameter are the parameters that are used in the <i>PaintL</i> instruction which are the Tool , Paint and Transport speed and zone information.	<ul style="list-style-type: none"> - Choose the tool to be used in the instruction. The tool list is referred from the Home tab. - Paint Speed is the velocity of the TCP when Painting - Paint Zone is the Zone value while Painting - Transport Speed is the speed of the <i>PaintL</i> instruction when the robot is not painting, i.e. moving between PaintStrokes - Transport Zone is the zone value to be used for the <i>PaintL</i> instruction when the robot is not painting, i.e. moving between paint strokes.
3	Specify Brush Parameters	<ul style="list-style-type: none"> - Start Brush Number : The Brush number to be used for Turning On the Paint flow - End Brush Number : The Brush number used to Turn Off

		<p>the Paint flow</p> <ul style="list-style-type: none"> - Approach Offset - A : The value in millimeter specifies the distance that the robot has to travel before turning on the Paint flow, i.e. the distance the robot needs to reach programmed TCP speed.. - Depart Offset - D : Depart offset is the distance the Robot has to travel after turning off the Paint.
4	Auto path generation parameters	These parameters along with the Paint and Brush parameters will be used when using Auto PaintStrokes functionality. The radio buttons show the various parameters and the path pattern for <i>Regular</i> and <i>Stay-On</i> painting.
5	Starting Corner - C	When user has to create a program on a <i>Panel</i> , user has to specify the starting point of the paint stroke. User can select from one of four corners of the Panel from where to start.
6	Pitch - P	Pitch is the distance between two parallel paint strokes
7	Hole Width - H	<p>Hole width parameter defines the minimum size of any Hole that will be identified during Path generation. For the identified holes, targets are created at the starting and ending point after Path generation.</p> <p>Holes along the path that are below the size are ignored.</p>
8	Offset - E	Distance from the Starting corner edge to the first paint stroke. This is usually half the Pitch size.
9	Trigger Off - O1	Distance that the Robot has to travel before turning off the Paint flow. A brush event is created at this point.
10	Trigger On - O2	Distance that the robot has to travel before turning on the paint. A brush event is created at this point.
11	Reduced Flow Brush number	This is the Brush number used to reduce the paint flow when robot is making a turn when using <i>Stay-On</i> painting
12	Reduced Flow Offset - O3	This is the offset distance before which the reduced flow event must be inserted before starting the turning operation and the distance turning before which the normal brush event is inserted when using <i>Stay-On</i> painting.
13	Turning Zone - Z	This is the Zone information used for the <i>PaintL</i> instructions which are used to make a turn in <i>Stay-On</i> painting.
14	Create a <i>New</i> Template	User can create a new template.
15	<i>Save</i> Template	User can save the template, the template will be stored as a part of the station internally.
16	<i>Export</i> and <i>Import</i> template	User can Export a template, the templates can be saved as <i>*.tpl</i> files. User can Import templates that have been created from other stations. When a template is imported and saved, then it is saved as a part of the station.

5.10 How to create a new paint program

Using Painting PowerPac RAPID modules can be created and procedures can be added to these modules. Painting programs have a naming convention that specifies that the program must have prefix 'm' and followed by the name.

Ex: m4, m5

The procedure also follows the same convention but that it is prefixed by 'main'

Ex: mainm4, mainm5

This section describes how to create a new Paint program using Painting PowerPac. In order to create a new paint program it is required that a Brush Specification has been created and that the workpiece is located in the station

Usage

Click on the "New" ribbon button in the "Paint Program" group, The dialog shown below opens



The screenshot shows a dialog box titled "Create Paint Program". It has a title bar with a close button. The dialog contains three input fields: "Program Name" with the text "m14", "Workpiece" with a dropdown menu showing "MobilePhone", and "Brush Specification" with a dropdown menu showing "mybrush". At the bottom of the dialog are two buttons: "Create" and "Close".

Description

	Item	Description
1	Program Name	The program name is automatically suggested as a number prefixed with 'm', ex. m5, m6 etc. The number is incremented automatically every time a new program is created. User can keep the name or enter a new one.
2	Workpiece	All the workpieces in the station are listed here. User can select the workpiece for the paint program
3	Brush Specification	The Brush specifications in this station are listed. The user can choose a brush specification to be used as reference in the program.

Once the user selects the options and clicks on "Create", a program and a procedure is created and listed in the Browser window. The procedure name will be 'main' followed by the program name. Ex:

'mainm14'. The *program.map* will also be updated with the information of the program and a corresponding default name will be specified in the mapping file.

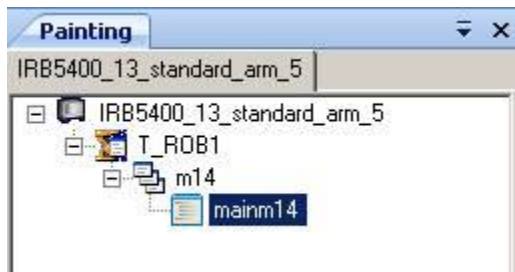
< System >

--- HOME

--- alias

--- program.map

Example: If module m14 has been created, then the default mapping in program.map would be **14**, **Program14**. Hence when user wants to append the same module to the Job Queue, then the name is reflected immediately.



5.11 How to Create Manual PaintStrokes

This section describes how to create paintstrokes using the Painting PowerPac.

Pre-requisites to start programming are that a Paint Program must have been created and listed in the Browser view of Painting PowerPac.

Clicking on *Manual PaintStroke* button in the ribbon tab brings up the following dialog in the Browser window

The screenshot shows a dialog box titled "Create Paint Stroke". It contains the following fields and controls:

- Name:** PaintDefaultTemplate
- System:** IRB5400_12_1200_1620_3
- Procedure:** FDoor_Left
- WorkObject:** wobj0
- Tool:** tool0
- Start Brush Number:** 2
- End Brush Number:** 1
- Bell Applicator
- Buttons:** Grid, Start, Clear

Description

	Item	Description
1	Template	User can choose any of the templates that have been created using the "Preferences" as described previously.
2	Select System	User can system to whose program & procedure the paintstrokes will be appended.

3	WorkObject	WorkObjects that have been created by the user from the Home tab in RobotStudio are listed here. User can choose the reference workobject for the PaintStroke. By default 'wObj0' is available and listed.
4	Tool	The tool information is automatically selected when the user selects the Template, however it is also possible for the user to change the Tool when programming a paintstroke.
5	Start & End Brush Number	The Starting and ending Brush numbers are also taken from the templates and can be changed for the Paintstroke. The values for the Brush numbers are referred from the Brush specification that has been selected when the program was created.
6	"Bell" type Applicator	Select this checkbox when using the applicators that are of the type "Bell". The x and y-axis orientation of all the Targets in the PaintStroke are the same with z-axis pointing normal into the surface at the target points. When creating subsequent PaintStrokes, the orientation of the targets are adjusted to minimize the Tool re-orientation when moving from one PaintStroke to another.
7	Create Grid	Use the Create Grid functionality to create a grid over the surface and use it as reference while making Paint strokes

Create a Simple PaintStrokes with Default Orientation

1. Click on the *Create PaintStroke* dialog
2. Select a Template from the drop down menu list
3. Select the reference Workobject
4. Click on *Start* and then click on the workpiece to teach the Paint program.
5. After clicking the Second point, the *Start* option in the dialog changes to *Stop*.
6. Click on *Stop*
7. The *PaintStroke* is created and appended to the Painting Browser tab.
8. The first and the last Targets are offset by the Approach and Depart distance specified in the Preferences Templates.
9. SetBrush instructions are inserted at the beginning and the end position of the PaintStroke. The position and the Offset distances are automatically calculated. The event position is indicated graphically.
10. After clicking *Stop*, the button changes to *Start* and is disabled. When creating multiple PaintStrokes, you can directly proceed to select points on the surface without needing to click on *Start* again.

11. In the process of Creating a PaintStroke, if you do not wish to save the PaintStroke, click on *Clear* button, this will remove the current PaintStroke.

See [Target Orientation](#) for more details on the orientation of Targets for different types of Paint applicators.

NOTE! The paintstroke is not appended if the user has closed the dialog before clicking *Stop*.

TIP! Use the keyboard key character '**s**' instead of clicking the button *Stop* for every paintstroke.

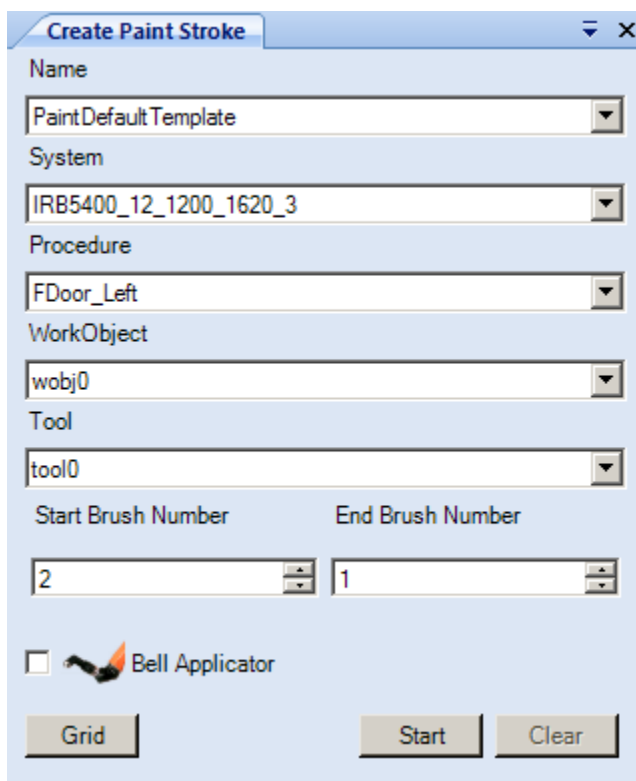
PaintStrokes are appended under the Painting Browser tab and are numbered PaintStroke_1, PaintStroke_2. The paintstrokes are appended to the procedure which is active. If user navigates to any other tab while creating PaintStrokes and returns to Painting, user has to select *Continue* in order to be able to proceed to create the programs.

5.12 Target Orientation

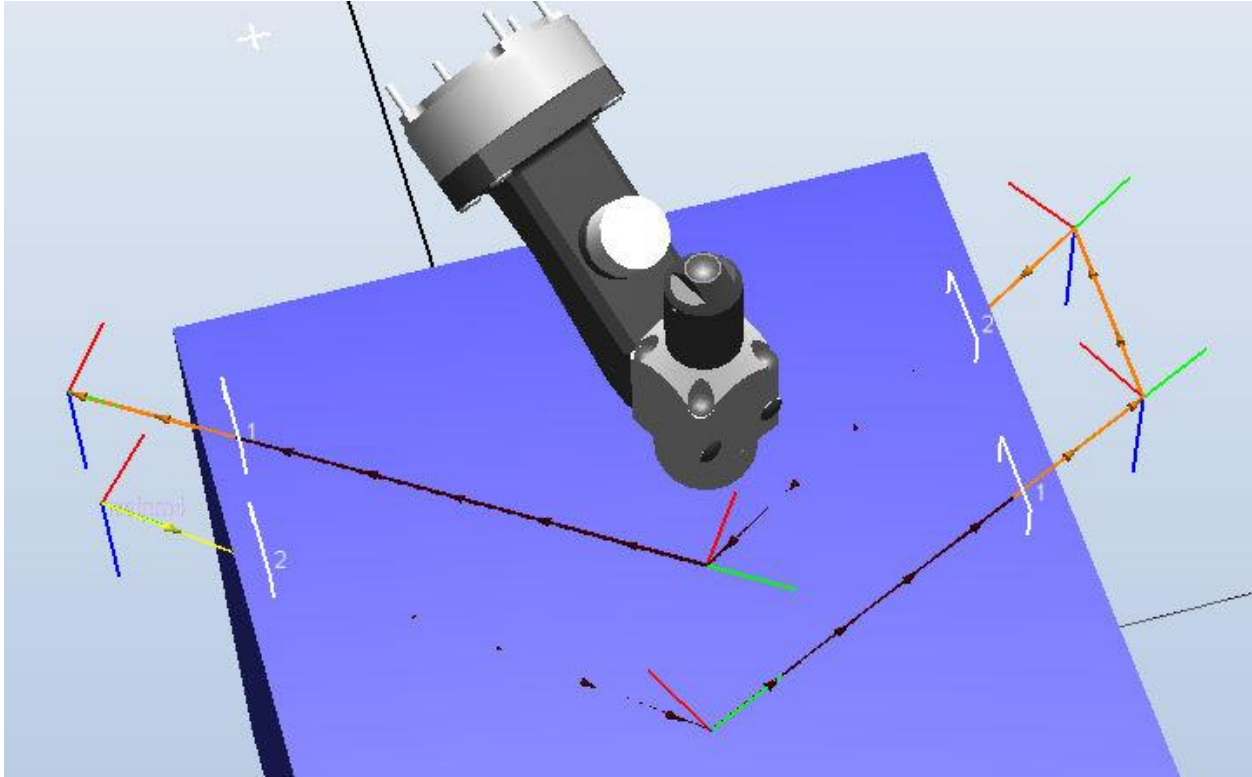
In Robotic painting the spray pattern is dependent on the type of Applicator that is used. Spray Gun gives an oval shaped pattern whereas for a Bell Cup type of applicator, the pattern would be circular. In Painting PowerPac, the orientation of the targets in the PaintStroke is decided based on the type of applicator used.

Regular painting

Paintstrokes created with regular painting are similar to using a "Spray Gun" applicator. In this applicator the targets are aligned such that the Y- axis of the target is pointing in the direction of the path and the Z – axis is normal and pointing into the surface.



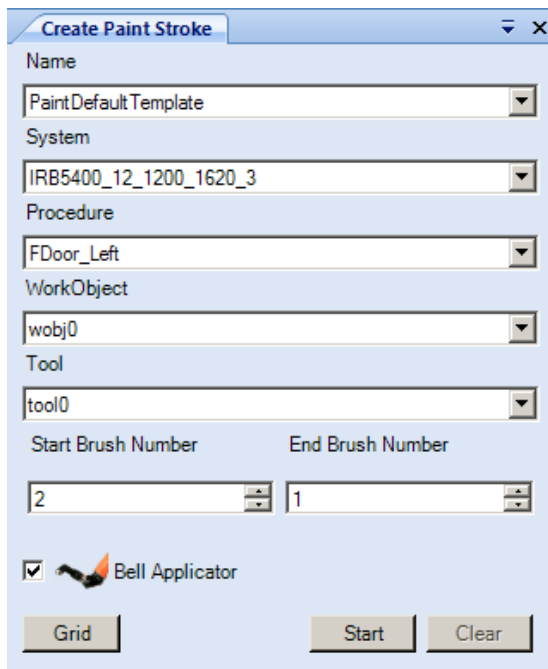
When creating subsequent PaintStrokes, the orientation of the targets are automatically adjusted to minimize the tool re-orientation when moving from one PaintStroke to another i.e., if the tool has to rotate >100 deg in order to align with the target in the current paintstroke, then the orientation of the targets in the PaintStrokes are aligned in the direction of the path and the rotated by 180 deg about Z-axis. This would minimize the tool re-orientation and is helpful when creating parallel PaintStrokes where the Tool orientation would not change. This is illustrated below.



PaintStrokes with a Regular (Spray-Gun) painting

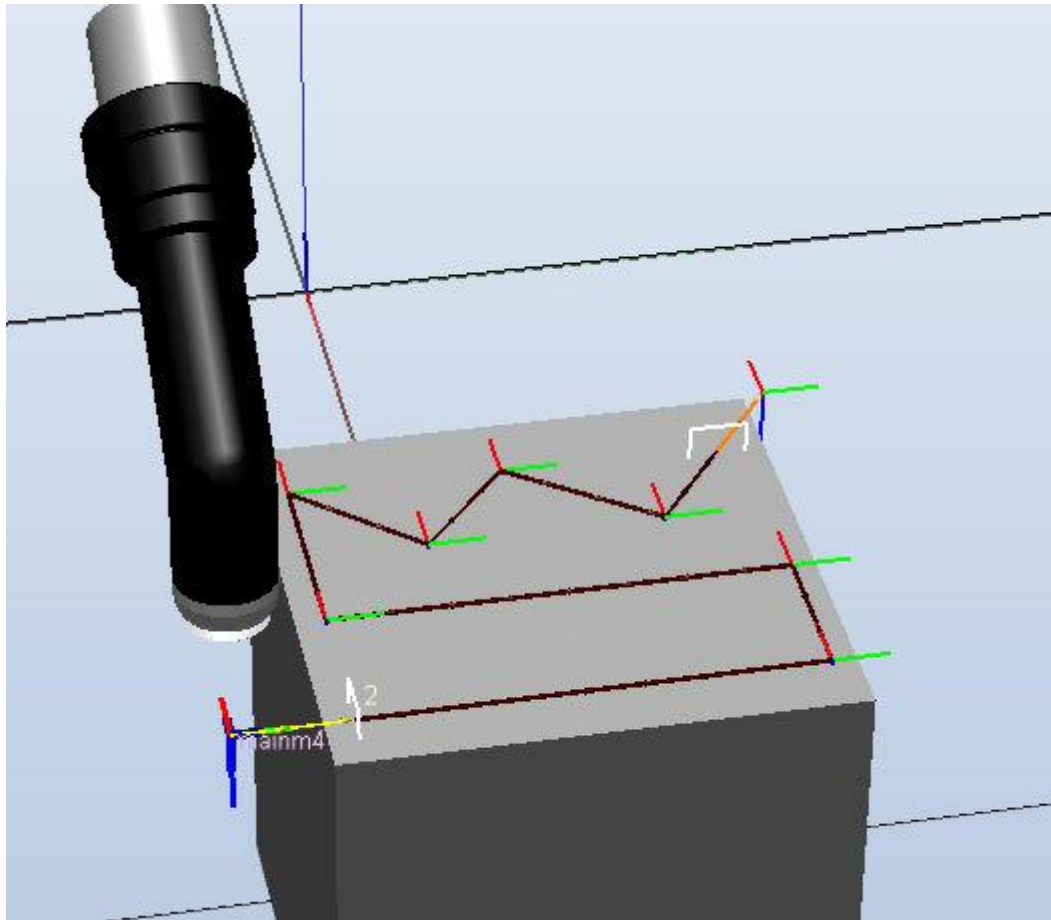
Bell type Applicator

This option can be selected from the check-box in the *Create PaintStroke* dialog. When this applicator is used, the spray pattern is circular, hence it is trivial to align the Y-axis of targets.



The first and the second targets are aligned so that Y-axis is pointing in the direction of the path. All the subsequent targets in the paintstroke have the same orientation as that of the previous target with the Z-axis points normal into the surface at all the selected points.

As the orientations of targets are similar, for most cases the robot does not need to re-orient much when moving along the path. This is illustrated in the below picture.



Paintstrokes with Bell-type applicator

Similar to the Bell-type applicator functionality, when moving between PaintStrokes based on the tool re-orientation required, targets are automatically reversed by 180 degrees about the Z-axis.

5.13 Auto PaintStroke

This section describes how to use the Auto PaintStroke option to create paths on Panels. The prerequisite for using the feature are

- A program must be created and listed in the Painting PowerPac browser window
- The Workpiece must be imported into Painting tab and *Panels* must be identified on it.
- User has specified the parameters in the *Preferences*

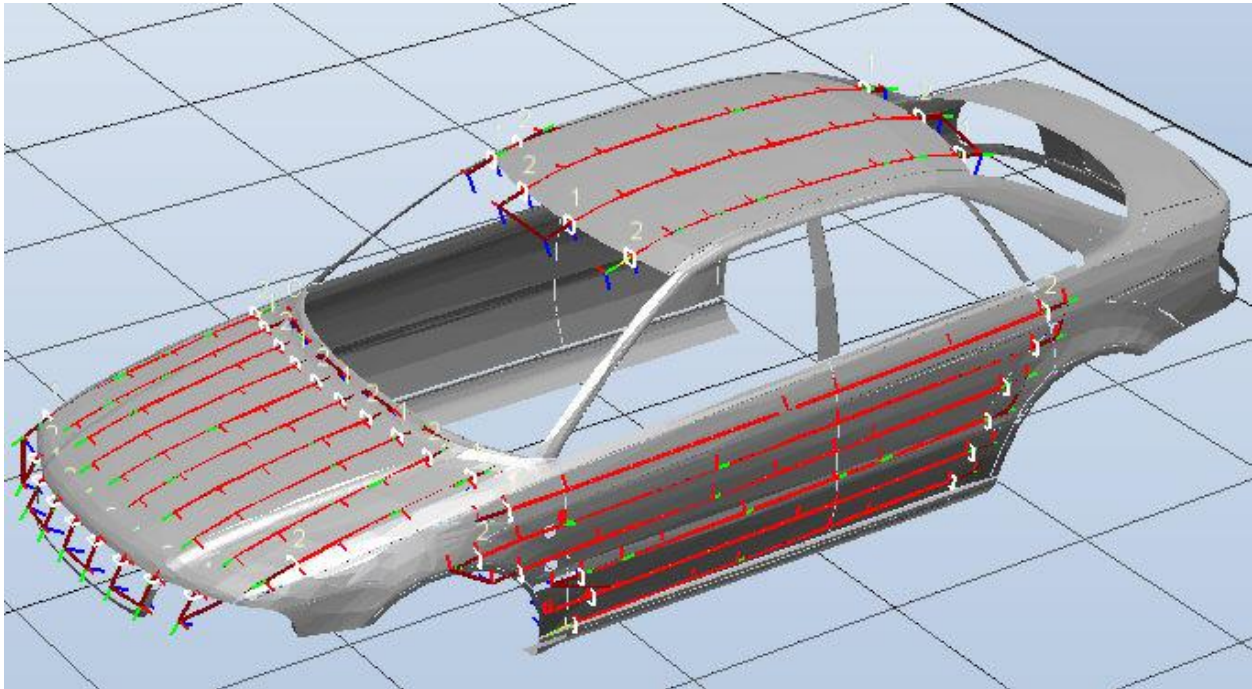


Figure 1

The Auto PaintStroke dialog can be launched either from the Ribbon tab or by selecting the option upon right click option on the Panel.

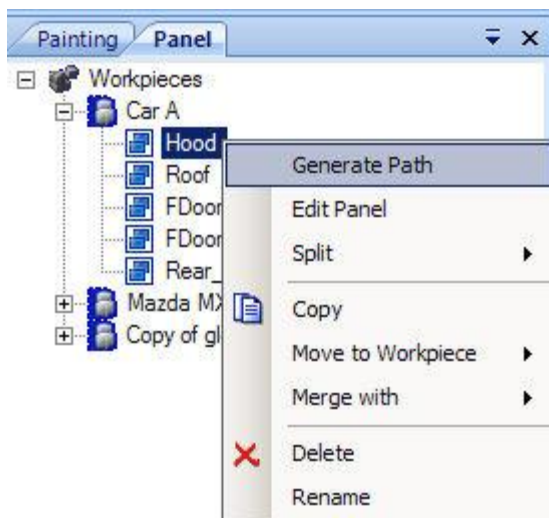


Figure 2

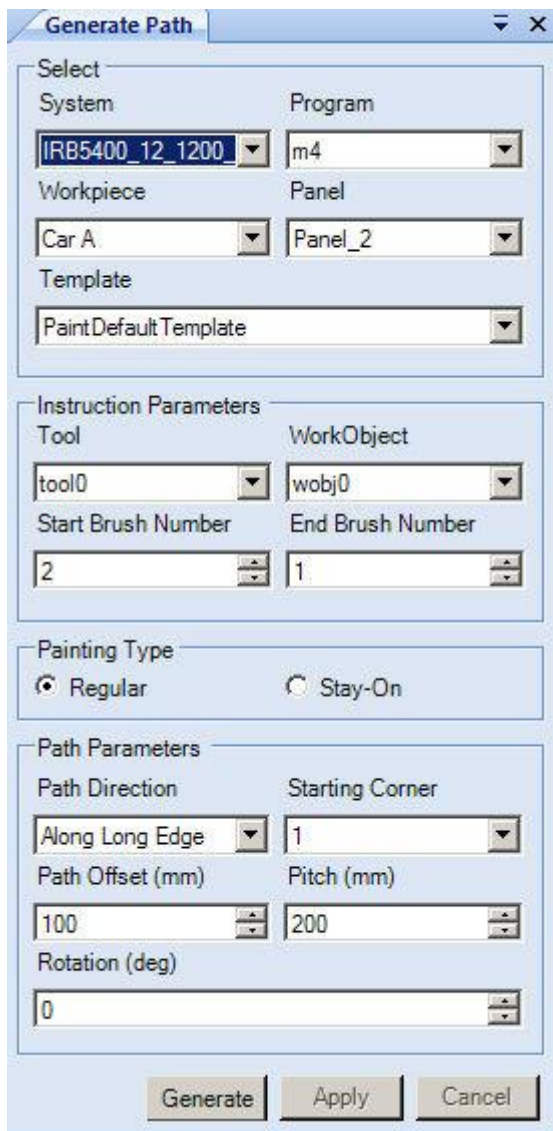


Figure 3

Auto PaintStroke Usage

	Item	Description
1	Open the dialog	The Auto PaintStroke dialog can be launched either from the Ribbon tab or by selecting the option upon Right click option on the Panel in the Browser window.

2	Select Workpiece, Panel and Template	<p>Select the workpiece on which the paint strokes are to be created. Once the meshed workpieces are selected, all the Panels associated with that workpiece are listed. Select a panel and ensure that it is highlighted in the graphical window.</p> <p>Select an available template from the station. By default based on the template all the values in the below groups are populated.</p>
3	Verify Paint parameters	<p>Tool, WorkObject, Start and End Brush numbers are populated based on the template selected. It is possible for user to select other available options which shall be applicable for that instance only.</p>
4	Select Painting type	<p>User can create paint strokes depending on the type of applicator. Painting type Regular indicates that the applicator is of Spray Gun type and Stay-On type is for Bell type of applicators. The paint path created is unique for each type of painting.</p>
5	Verify Path parameters	<p>Some of the Path parameters are presented to the user. It shall be possible to user to modify these parameters to check various combinations while creating paint strokes.</p>
6	Path Direction	<p>While creating a Path on a Panel, user can choose the direction of the path to be</p> <ul style="list-style-type: none"> - Along Long Edge - Along Middle Edge - Along Short Edge
5	Click on Generate button	<p>Generate button creates a Path on the Panel using the selected template parameters. The SetBrush instructions at the starting and ending points of each paint stroke are also automatically generated.</p>
6	Click on Apply or Cancel	<p>When user clicks on Apply, the path will be stored. Individual Paint strokes will be identified and appended to a procedure with the name associated with the Panel.</p> <p>When user clicks on Cancel, the created Path will be discarded. User can choose another combination of parameters and generate the path again.</p>

Direction

A Panel is a 3-D model over which the path is generated. The direction of the Path can be along the Long, Middle and Short edges.

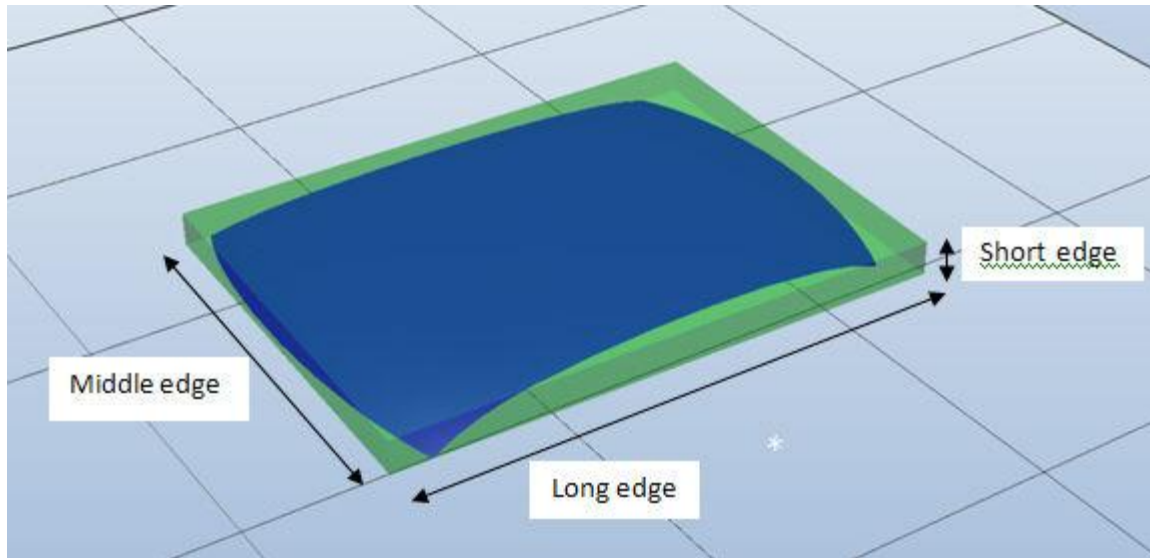


Figure 4

The above picture shows the Panel Hood of a car which is enclosed within a box.

Along Long Edge - When the program is created along the longest side of the Panel (box)

Along Middle Edge - When the program is created along with second longest side of the Panel

Along Short Edge - When the program is created along the shorted side of the Panel, in this case the vertical side of the box.

Starting Corner

Starting corner of the path can be selected by a drop down menu showing 1, 2, 3 & 4 as options. When user selects a particular corner and clicks on Generate, the selected corner is indicated by letter C after the path has been created. The other points can be located by moving the counter-clockwise direction from the current starting corner point.

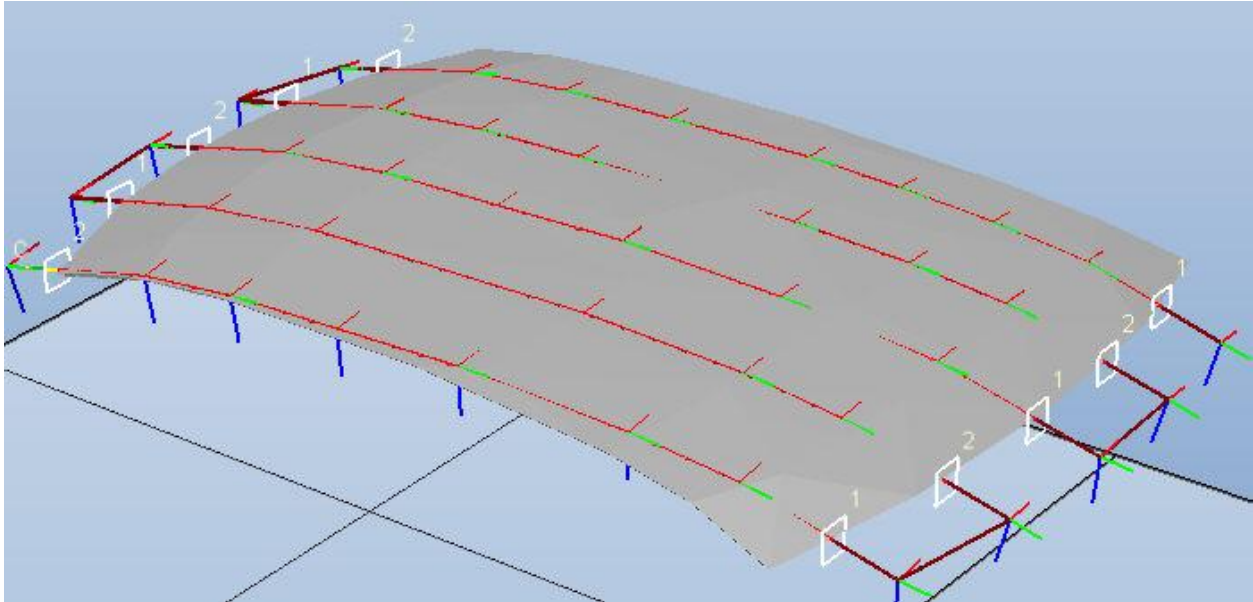


Figure 5

Holes

If there are holes in the panel and along the path and the size of the hole is larger than the specified value in the template, then targets will be created at the starting and ending point of the hole along the path. User can insert Events at these positions. Holes that are smaller than the specified size will be ignored. A hole can be any natural gap on the divided model.

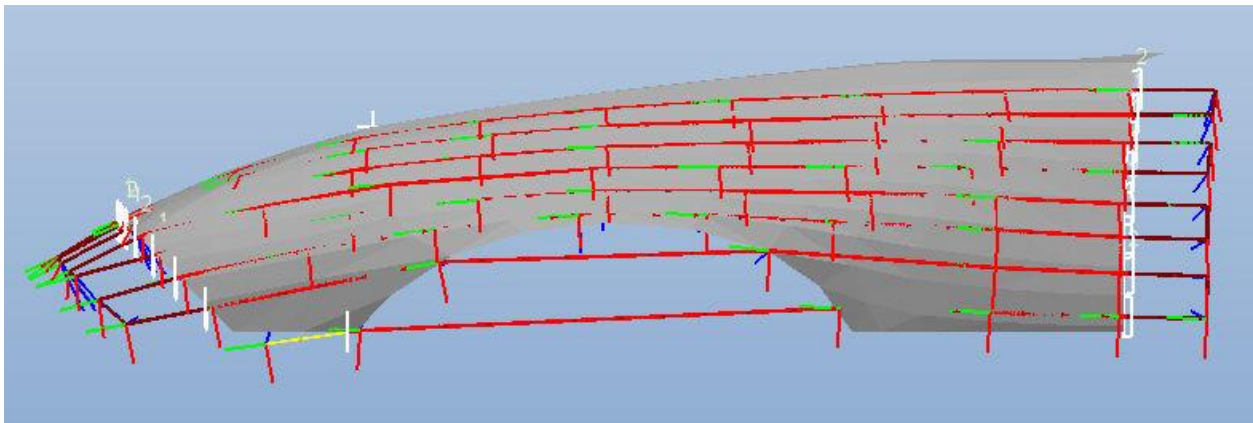


Figure 6

Pitch

Pitch describes the distance between two parallel paths. User can change the Pitch value from the dialog.

Paint Strokes

Paint strokes are created when user clicks on *Generate*. The path generated depends on the type of painting applicator used.

1. Regular - *Spray gun* applicator
2. Stay-On - *Bell* type applicator

The paint strokes created for each type are a result of the spraying pattern for each applicator.

Regular Painting

Regular painting means Paint strokes are created when *Spray-Gun* type of applicator is used. The spray pattern is primarily oval, hence the path generated will have multiple parallel paint strokes such that the applicator tool orientation is same such that the spraying pattern is uniform . Each stroke is identified by a Start and End Brush trigger events placed at the edge of the panel as shown below.

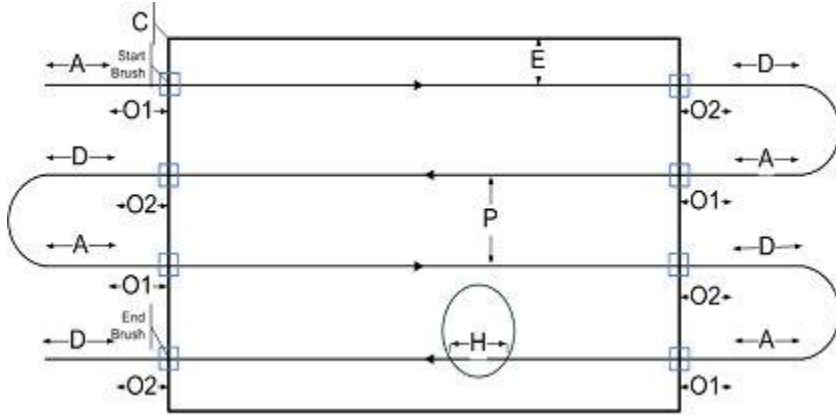


Figure 7

The path generated when painting the roof of the car is as indicated below

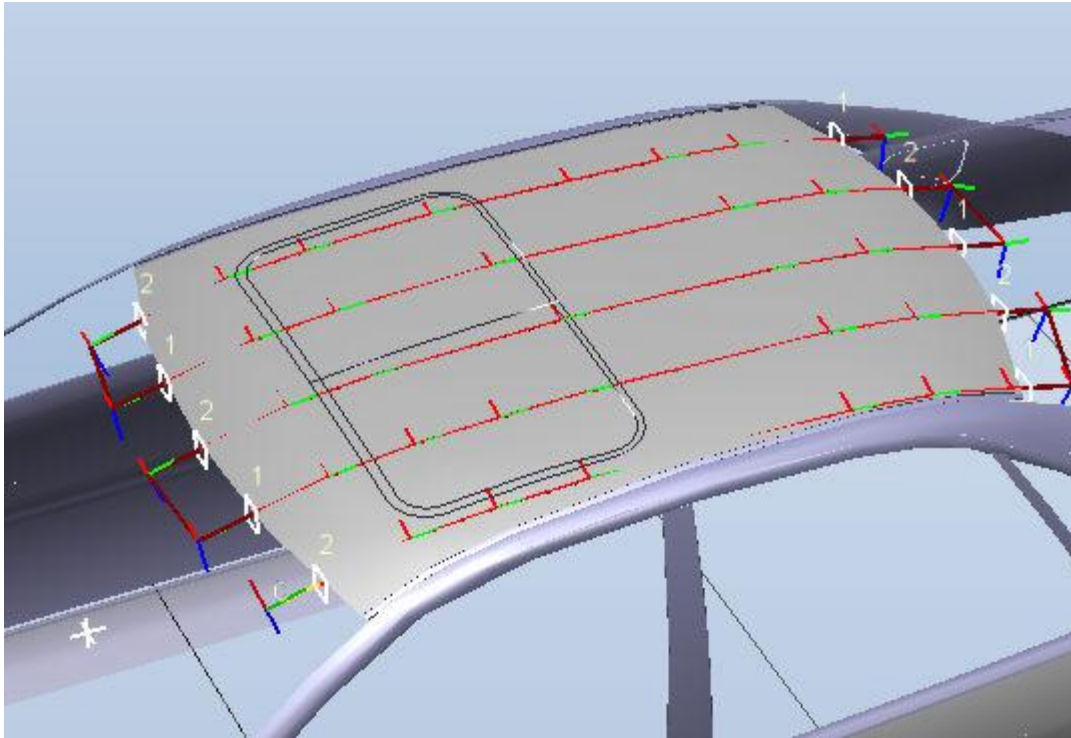


Figure 8

The orientation of the RobTargets are such that the Z - axis is pointing into the surface and Y - axis is pointing in the direction of the path. The number of targets created depends on the CAD model.

Stay-On Painting

Stay-On painting is used when Bell type of applicators are attached to the robot. The spray pattern from a Bell type applicator is primarily circular, hence the spray pattern is uniform irrespective of the applicator orientation.

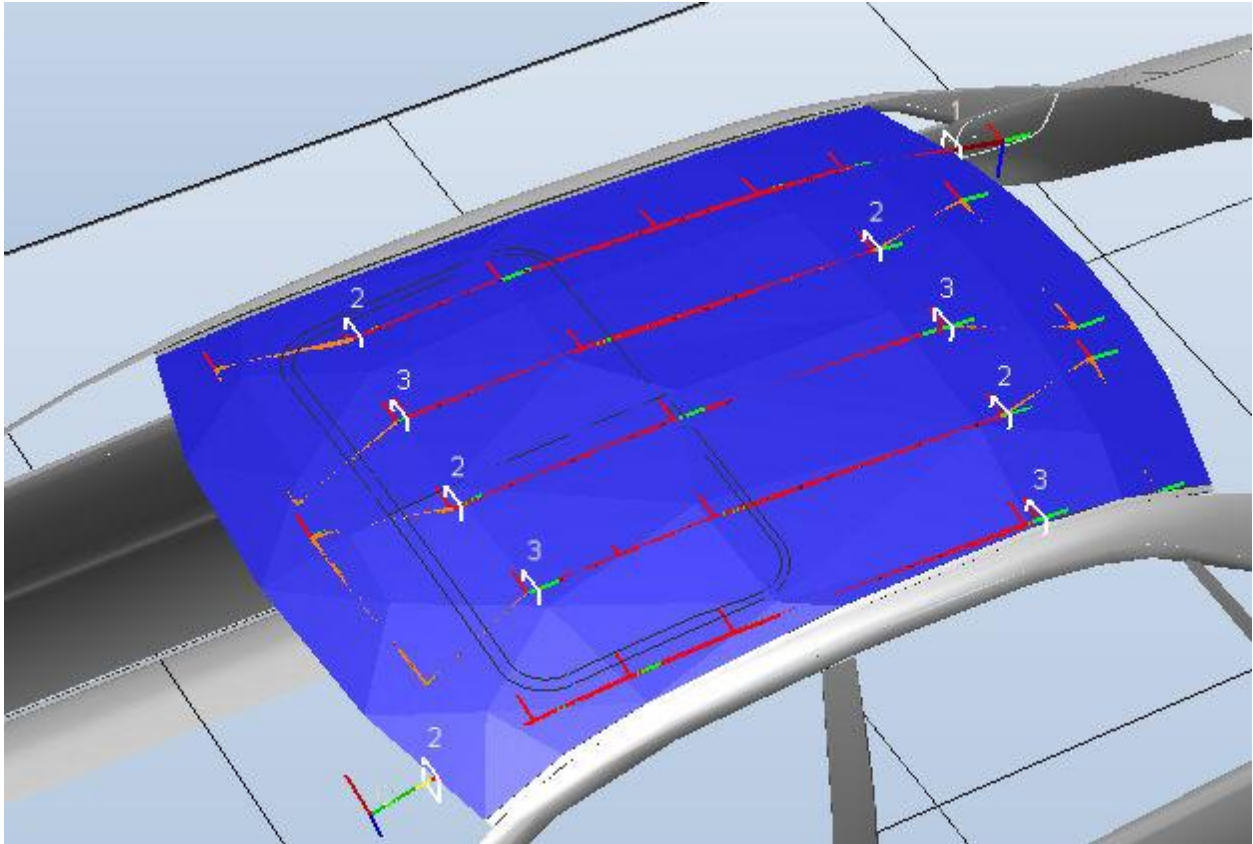


Figure 9

One paint stroke is created when Stay-On painting is used as it is not necessary to turn off the paint flow as all the targets except the initial Turn-On and the final Turn Off events are within the Panel.

The path generated follows the guidelines as shown below

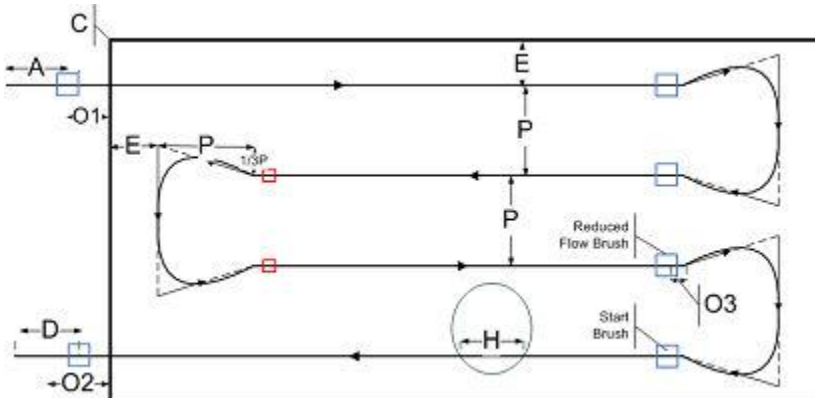


Figure 10

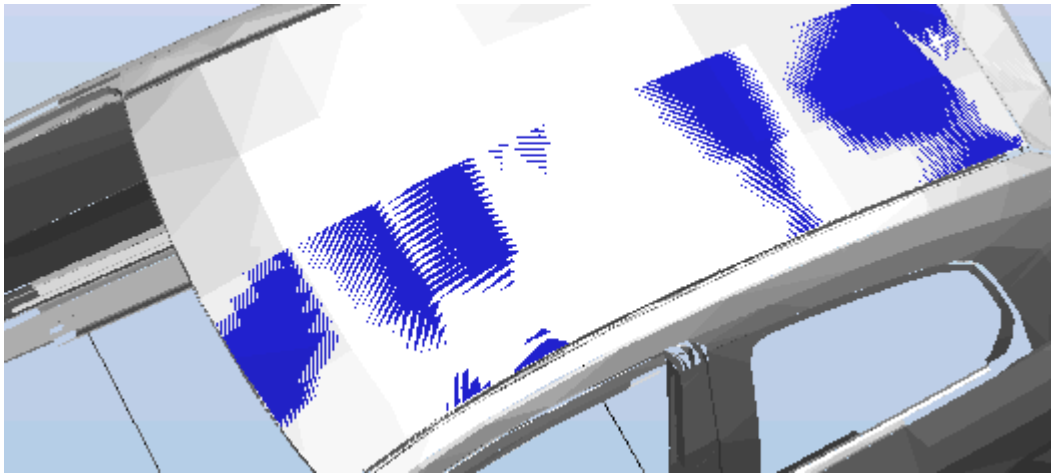
The spray pattern is not affected by the tool orientation when moving along the path. When moving from one parallel segment of path to the next, the robot has to make a smooth transition, hence the two targets are placed with a little offset. The *Turning Zone (Z)* for these PaintL instructions can be specified by user in *Preferences*.

When making a turn, usually the paint flow is reduced. The *reduced flow* brush event is created and placed at an offset (O3) before the instruction which starts to take the turn. After the robot has made the turn, the Start brush event is placed with the same offset distance to resume normal painting and at the end of the paint stroke the End brush event is inserted to turn off the paint flow. User can specify the Brush numbers to be used for Start, End & Reduced flow trigger points.

Example scenarios

- Multiple layers in CAD model

Sometimes CAD models have multiple layers. User might have selected only the top surface of the workpiece while creating the Panel, however the path generated might not be as expected. An example of multiple layers is shown below



In this case, delete all duplicate layers and ensure that there is only one layer which defines the surface to be painted.

- RobTarget Z- axis is not pointing normal into the surface

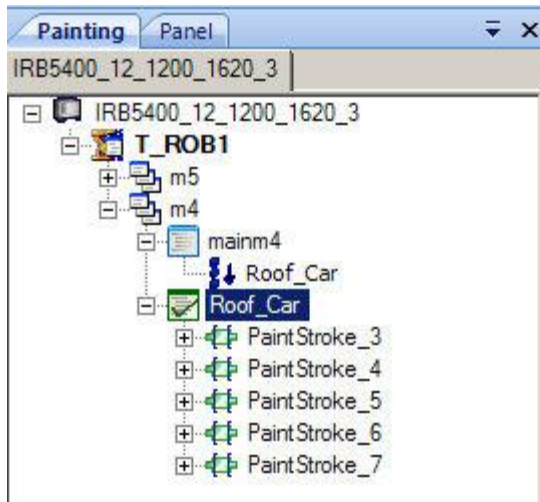
This scenario may occur in some CAD models, however the Z-axis would be pointing normal out of the surface. In this situation, user can choose *Adjust Position & Orientation* feature from the context menu of the PaintStroke to rotate the RobTargets by 180 degrees.

- Stay-On painting is creating paint strokes which are not similar to the template

One reason could be that the Pitch and Edge values are not proportional to the edge length. Modify the same to be proportional with the size of the edge along the path direction.

Paint Strokes

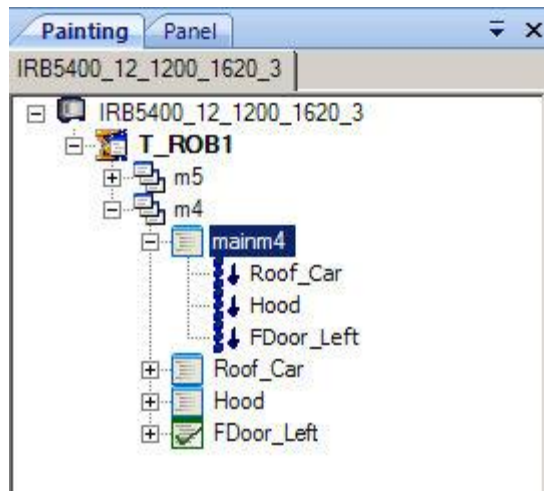
Once user generates paint strokes and commits them by selecting *Apply*, the paint strokes are appended in a procedure in the selected controller's program. The name of the procedure is similar to the corresponding Panel name.



Also the procedure call is automatically appended in the *mainm* procedure of the program to fasten the process of identifying a painting sequence.

5.14 How to specify a Painting Sequence

Painting sequence means specifying the sequence of execution of procedures when a program is running. It is possible to setup the Painting sequence for the procedures created by Painting PowerPac.



To specify the painting sequence, select a procedure and drag and drop it under another procedure in the same program. A sequence node is created which has the same name as that of the procedure. When user synchronizes the program and procedure into the Virtual controller, the RAPID code contains the procedure call.

The procedure calls in RAPID procedure mainm are as below

```
PROC mainm4()
```

```
    Roof_Ca
```

```
    Hood;
```

```
    FDoor_Left;
```

```
ENDPROC
```

User can drag and drop a procedure in a program any number of times to any procedure in the same program, the corresponding node is created in the target procedure. It is possible to rearrange the sequence of the nodes by right click operation on the sequence node.



The painting sequence node is an action instruction node which is created in RobotStudio with the same name as that of the procedure. The sequence node operations and behaviour are as described below.

	Item	Description
1	Delete Template	Deletes the node
2	Move Up	Moves node one level up. If the above node is a PaintStroke node, then the sequence node is inserted above it.
3	Move Down	Moves the node one level down
4	Rename of Procedure	Renames the Sequence node
5	Delete Procedure	Deletes all the corresponding sequence nodes in the program
6	Synchronize to VC	The procedure calls are inserted at the specified locations in the Rapid programs in the virtual controller when synchronizing to virtual controller
7	Synchronize to Station	If the sequence of procedures are modified in RAPID (rearranged or added), then the corresponding positions are reflected in painting tab.

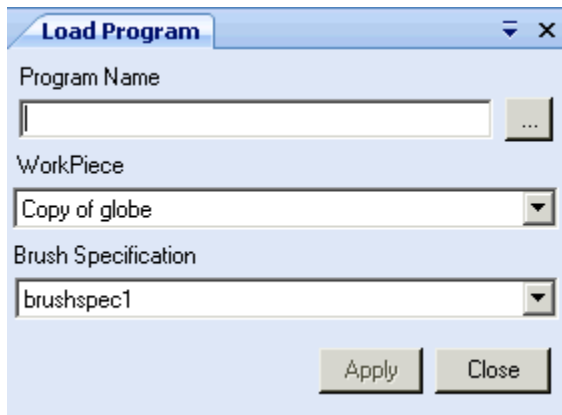
5.15 How to load existing Paint Programs

Overview

This section describes how to open an existing painting program into Painting PowerPac.

Usage

User can load an existing program by clicking on the Ribbon tab button "Load". This opens a dialog as below



Description

	Item	Description
1	Program Name	User can browse to select the program (*.mod)
2	WorkPiece	CAD models that are to be associated with the program can be specified
3	Brush Specification	Select the Brush specification to be associated with the program

When the user selects a program to load and clicks on *Apply*, the program is validated and loaded into the station. The module and the procedures are appended to the Browser window and the instructions are added under PaintStroke. *PaintL* and *SetBrush* instructions are supported in the PowerPac.

The Program is represented as different PaintStrokes based on the SetBrush number and its corresponding value in the Brush Specification.

In the Brush Specification if the value of *Width* and *Length* are 0 for a particular brush number, that indicates that it is the Brush used to *Stop* the Paint. The Paint program is segregated into paintstrokes based on the Brush numbers with (0, 0) as values in the Brush Specification.

5.16 Brush Tables and Virtual Applicator

This section describes how user can create Brush Tables and work with Virtual Applicator (VA). When user creates Paint systems in RobotStudio and works with Painting PowerPac, an IPS folder is created under the system folder.

System

----- IPS

----A1Brush

---- Table1.bt

---- Table2.bt

---- Table3.bt

Brush tables that are used in the system are placed in this location. The brush tables are used in Painting PowerPac for the Virtual Fluid Device where user can get the Gun-On time and the Material consumption.

The option is launched when user selects the Edit Brush Table option from the Brush Table group in the ribbon tab.



The dialog that opens when user clicks on the button depends on whether the Virtual Applicator license has been installed or not. The two options and their usage are described below.

Normal Brush table editor

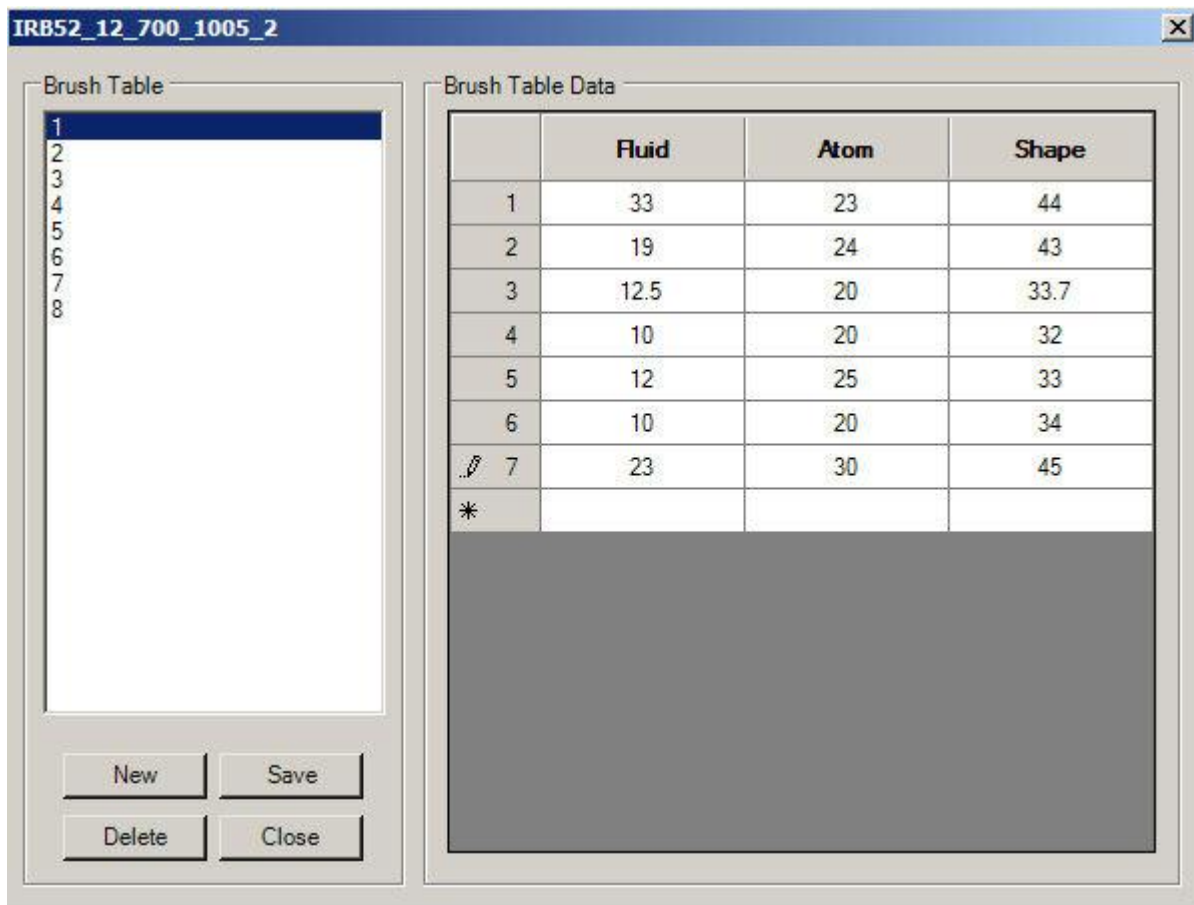


Figure 1



Figure 2

Description

	Item	Description
1	Brush Table and Brush Table Data (Figure 1)	All the Brush tables associated with the System are listed. When user selects a table, the associated values are shown in the right side under the respective columns.
2	New Table (Figure 2)	<ul style="list-style-type: none">• Table Number xx - Suggests the first available table number in the current system. User can also change it. If there exists an• 3 columns - Fluid, Atom, Shape 4 columns - Fluid, Atom, Shape1, HV 5 columns - Fluid, Atom, Shape1, Shape2, HV• Based on Existing Table - User can create a new table based on an existing one. A new table is created having the same values as the existing one.
3	Save	Save the table under the current System.
4	Delete	Selected Brush Table will be deleted from the System folder

Brush table editor with Virtual Applicator

When user has the VA license installed on the computer, an extended dialog opens as shown below

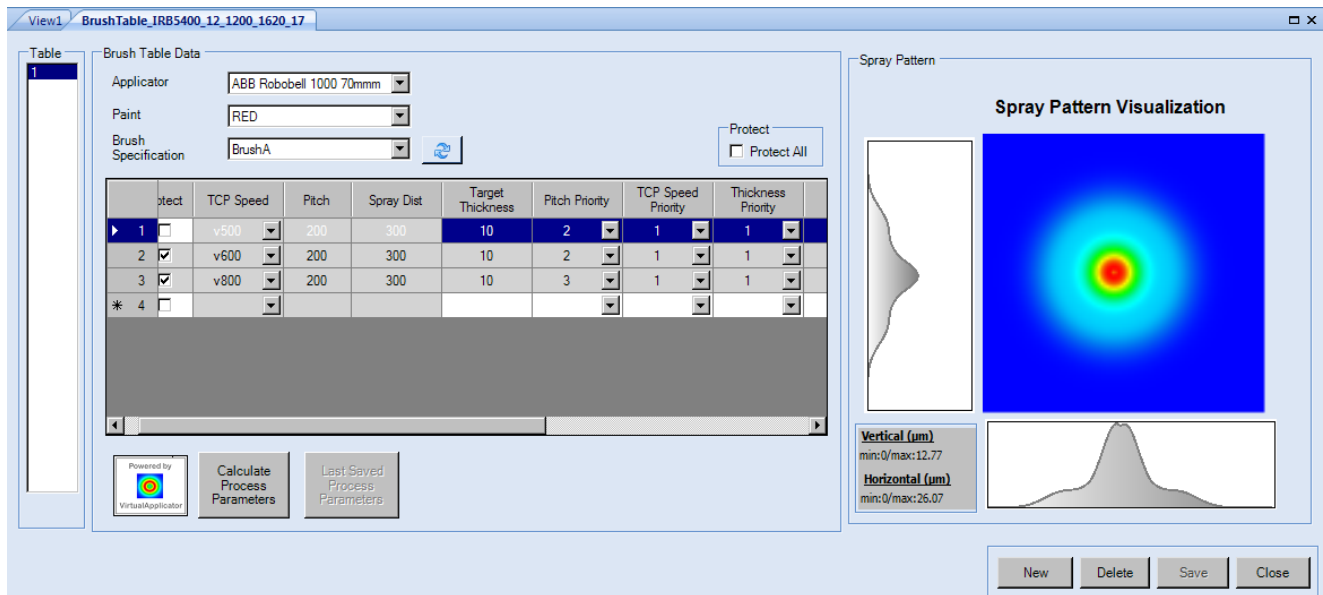


Figure 3

Description

The Virtual Applicator service requires some inputs to calculate the brush tables.

The inputs to the VA that are specified by the user are

1. Paint Specification
 - Paint Groups
 - Nominal Thickness
 - Viscosity
 - Solid Content %Volume
2. Brush Specification
 - TCP Speed
 - Pitch
 - Spray Distance
3. Brush Table Editor
 - Applicator
 - Target Thickness
 - High Voltage (kV) - optional
 - Atom (krpm) – optional
 - Thickness priority

- Pitch priority
- TCP speed priority

The output from the VA Service is the Brush tables with 5 columns as

1. Fluid
2. Atom (krpm)
3. Shape1
4. Shape2
5. HV (kV)

	Item	Description
1	Brush Table and Brush Table Data (Figure 1)	All the Brush tables associated with the System are listed. When user selects a table, the associated values are shown in the right side under the respective columns.
2	Applicator	Select from a list of Applicators that are defined in the VA Service. If user is not connected to network, then an option None is also listed. However it is a pre-requisite that an Applicator must be selected to get the Brush Table from the VA Service.
3	Paint	Select the Paint defined in the Paint Specification
4	Brush Specification	Select a Brush Specification from the list. The table is populated with the Brush Table values for TCP Speed, Pitch, and Spray Distance. All the columns are grayed out such that user cannot modify them. However user can also modify some values in the dialog. To do so, user must select the option None in the Brush Specification. Then user can edit the values.
5	Target Thickness	Specify the required thickness of paint on the workpiece. Datatype - micro meter
6	Priority	Specify priorities for Thickness, Pitch and TCP speed. The priority classification is 1 - High 2 – Medium 3 - Low The process parameters are optimized based on the priority.
7	Calculate Process Parameters	Once user calls the Calculate Process Parameters button, then the VA Service processes the inputs and returns the Brush table value for each row. The service always returns 5 columns irrespectively of how many are present in the table currently.

8	Last Saved Process Parameters / Generate Process Parameters	<p>After user has clicked on Generate process parameters, the Brush table is updated with values from the Virtual Applicator. User can verify by toggling between the last saved values of the Brush table & the current values.</p> <p>The process parameters that are changed by the Virtual Applicator are highlighted.</p>
9	Protect All	<p>User can Protect the Brush table thereby preventing any modification of the values in the Brush numbers for any changes in either the Applicator or Paint & Brush Specification.</p>
10	Save Brush table	<p>Saving the Brush Table when the VA License is present stores all the associated information present in the dialog at the time of saving in addition to saving the table values of Fluid, Atom, Shape etc. as a Table1.bt under the system folder.</p> <p>Subsequently when user closes and opens the dialog and selects a table, then all these options are also selected along with the Brush table.</p>

NOTE ! - Only when the RobotStudio Station is saved, the values in the Brush table other than the Process parameters will be saved i.e. the Applicator, Paint & Brush specifications etc.

Currently the following set of Applicators are supported in the Virtual Applicator for generating the Process parameters

- ABB Flexbell G1 Copes
- ABB Robobell 625 50mm
- Pneumat 1 DeV797 - 1.2 mm
- ABB Robobell 1000 70mm
- ABB Robobell 1000 40mm

Spray Pattern Visualization

The spray pattern for a specified brush number in a brush table is the visualization in the form of an image of the paint deposition when the applicator is spraying paint for a period of 1 sec on a flat area of size 1 * 1 meter.

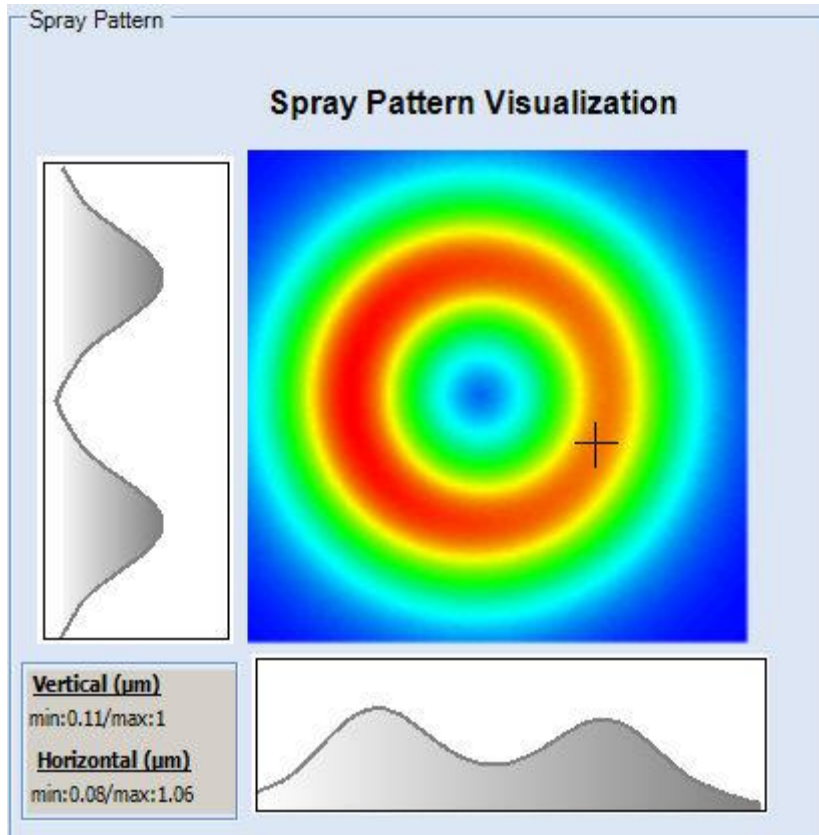


Figure 4

The spray pattern image is created by calling the Virtual Applicator service. Hence user needs to be connected to network for visualizing the spray pattern. The service is invoked by selecting the Brush number row as shown in Figure 3 above.

The required inputs generating the image are

1. Paint Specification
 - Paint Groups
 - Nominal Thickness
 - Viscosity
 - Solid Content %Volume
 - Paint Groups
 - Nominal Thickness
 - Viscosity

- Solid Content %Volume
2. Brush Values
- TCP Speed
 - Pitch
 - Spray Distance
 - Target thickness
 - Process parameters - Fluid, Atom, Shape, Air1, Air2, HV

The thickness profile on the spray pattern at any point can be visualized by selecting any location on the image. The corresponding horizontal and vertical thickness profile for the selected row and column of the location are displayed along with information of the min and max values of all the elements in the row & column.

The spray pattern for a given brush number in a Brush table is not changed unless any value that has been used to get the spray pattern has changed. User must select the Brush number again to get the spray pattern for the modified brush table.

5.17 How to work with Job Queue

This section describes how user can work with the Job Queue option to visualize production using controls similar to those on the Paint Teach Pendant Unit.



The pre-requisites for working with the Job Queue are

1. Programs must be saved in the *System/HOME/programs* folder
2. The mapping files, *program.map* and *material.map* files must be filled with the corresponding entries. The files can be located under *System/HOME/alias* folder

Mapping and Index files

Paint programs are identified by the letter m followed by a unique number (program index)

Ex : m1, m2, m3, m4

The *Program.map* file maps the program index to the program alias. The alias name is to help user to easily identify a program

Ex:

- 1, Program1
- 2, Program2
- 3, Program3
- 4, Roof
- 5, Door

The *Material.map* file maps the material index to the material alias. The material alias is to help user to identify a material easily.

Ex:

- 1, Material1
- 2, Material1
- 3, Material3
- 4, Red
- 5, Blue

A1BTab.ndx file present under System/IPS/ folder is used to specify the mapping between the material index and the corresponding Brush table number.

Ex:

- 1, 3
- 2, 4
- 3, 1
- 4, 5
- 5, 2

If there are no entries in the A1BTab.ndx file then the material index will by default be mapped to corresponding Brush table index files.

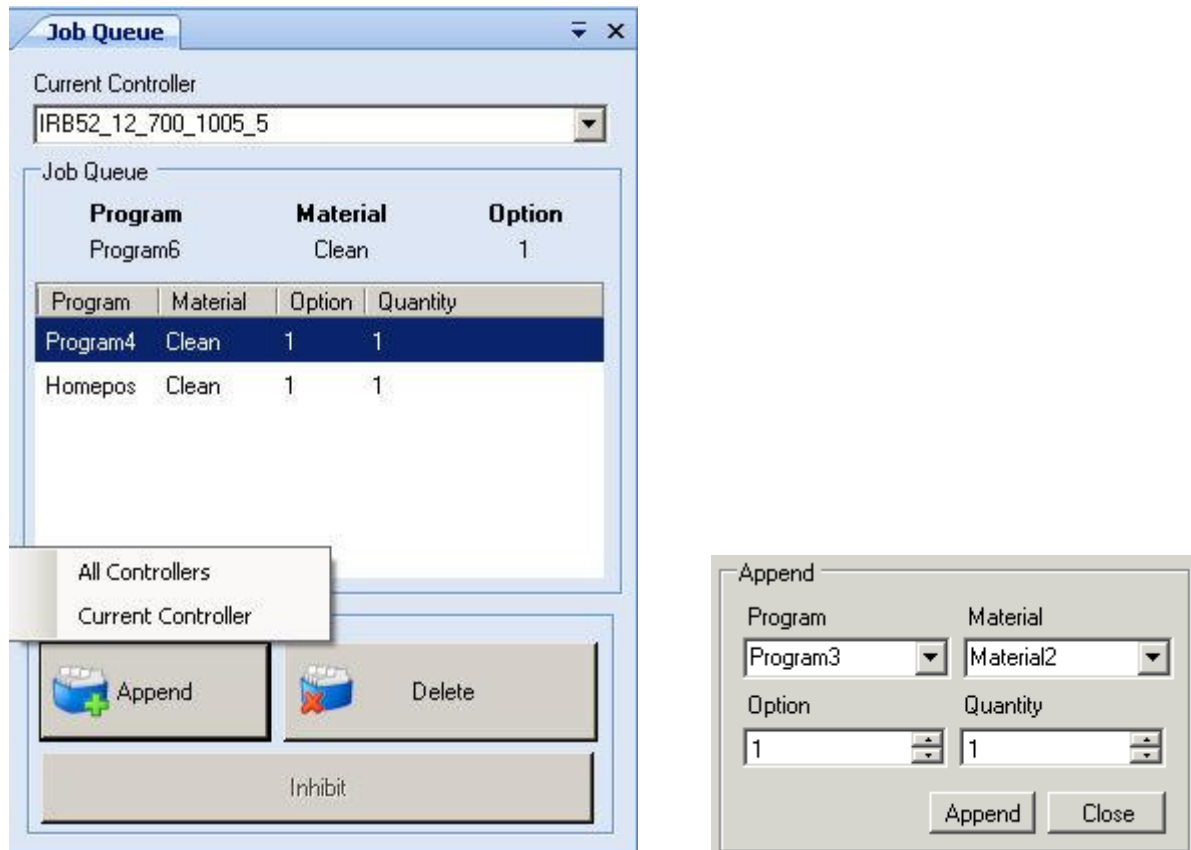
When working with Painting PowerPac, the program.map file will be automatically filled. User must ensure that the material.map and the A1BTab.ndx file values are specified.

Usage

User can do the following options using the Job Queue

	Item	Description
1	Append	User can append a job to the controller/controllers.
2	Delete	User can delete job/jobs from controller/controllers
3	Inhibit/Resume	When running the job in Production mode, user can Pause and Resume the production.
4	Job Queue	User can see the jobs in the Queue and the currently executing job.

Append



User can append a job to the current controller or to All controllers in the station. User needs to specify

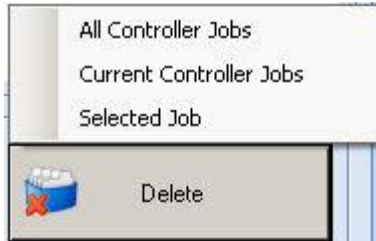
- Program
- Material
- Option
- Quantity - Number of times the program must be executed

When user selects to append job to the current controller, then all the Program and Material information present for that controller are listed. When user selects to append job to all the controllers in the station, then all the information is combined and presented to the user. User must ensure that the mapping information in the controllers correspond to each other. If there is any mismatch, then the information is shown to the user in the output window.

Delete

User can delete jobs from the queue. Delete options:

- Delete All Controller jobs
- Delete Current Controller jobs
- Delete Selected Job



When a selected job is deleted from the queue, then all the jobs below that are shifted upwards. When all controller jobs are deleted, then except for the currently executing job, all the jobs in the queue are deleted.

Ex: If user appends a job with quantity 10, then Deletes the job during the 5th execution, then the current execution continues until completion and then stops, because the subsequent jobs are deleted.

Production Visualization

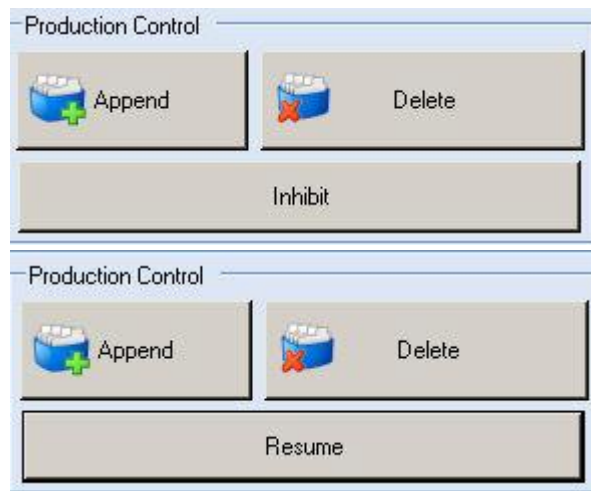
User can visualize the Production after appending jobs to the queue by clicking on the Play-button from Graphics or from the Simulation tab in RobotStudio. To start the production, the Entry point for the simulation must be in the main module.

When the Job Queue dialog is opened, then it is assumed that the user wants to visualize the Production and hence if there is no simulation running, then the entry point for each controller is set to their corresponding main procedures. When jobs are in queue and user clicks on Start simulation, then all the controllers are started simultaneously and start executing the programs as listed in the Job Queue.

During production the program that is to be executed is loaded into RobotStudio to the Offline tab from the *System/HOME/programs* folder and after execution it is deleted from the Offline tab. i.e only the currently executing program from the programs folder is listed in the Offline tab.

Inhibit and Resume

User can *Inhibit* (Pause) and *Resume* the production from at any point. When a program is Paused during execution, then it completes the currently executing task and then pauses. The simulation status however doesn't change to *Stop* and the controller is still in the *Start* state. When Resume is selected then the production continues as normally. High priority jobs such as *HomePos* are executed irrespective of whether Inhibit or Resume was activated.



TIP! Sometimes jobs might not be appended to the controller because controller might give Socket error, Try to Close and Re-open the Job Queue dialog box and try again.

If user is not able to append jobs to the controller because of any reason, restart the controller and then try again.

NOTE! When working with Job Queue, the Material supply will always be enabled if Color change option is selected in the System.

5.18 How to work with Virtual CBS

This section describes how to use this feature to visualize the production when the system is configured with a CBS option. The time taken for color changing operations etc. can be checked by allowing user to set the values for the CBS parameters.

This feature is enabled only if the system is CBS enabled.

Usage

By default Paint systems do not have this option selected. The CBS option can be enabled while creating a system from the Modify Options dialog as shown below.

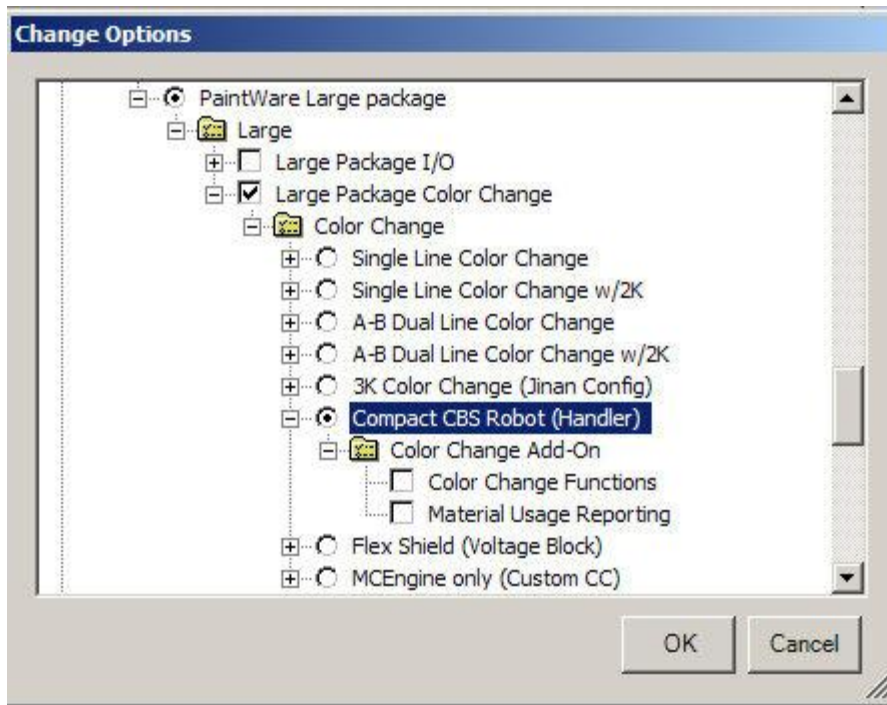


Figure 1

When a Paint Station has this option, then the option is enabled in the Painting PowerPac.



Figure 2

When user clicks on this button, a dialog opens up as shown

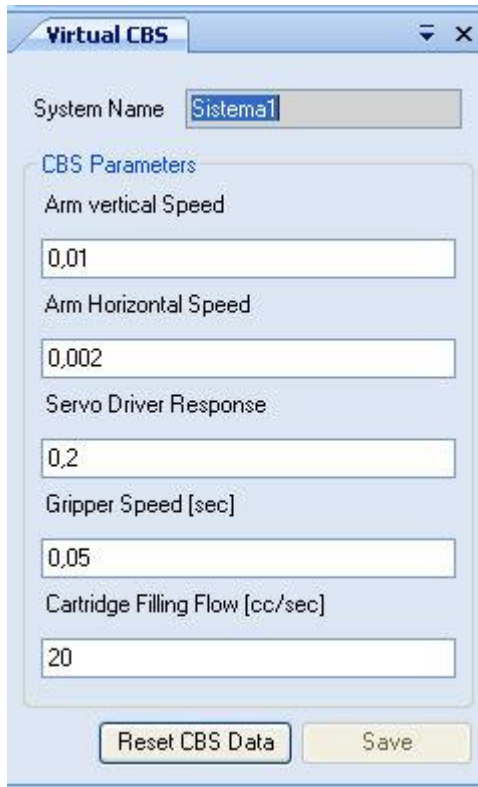


Figure 3

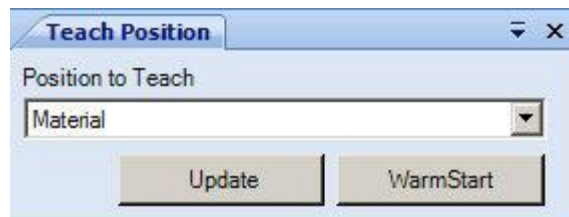
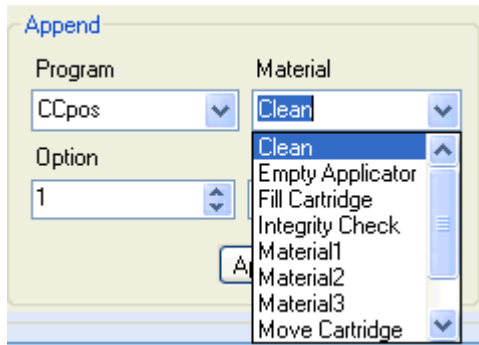


Figure 4

Usage

	Task	Description
1	Select a system with CBS option selected and Activate PowerPac	The Virtual CBS option will be enabled
2	Teach the Material Change position (Figure 4)	Jog the Robot to the Material Change position. Update the position and Restart the controller
3	Specify the CBS Parameters and click on "Reset CBS Data" from the Virtual CBS dialog (Figure 3)	The specified CBS parameters values will be updated and used whenever the Reset CBS Data is specified and a material change is invoked
4	Append Jobs from Job Queue with different material	When there is a material change from one job to another, the Robot will move to the Material Change / CBS position and wait for the time specified in the Virtual CBS dialog and then it proceeds to execute the job.

In CBS systems a number of instructions are listed under Material as shown in below picture



These additional tasks of "Empty Applicator", "Fill Cartridge", etc are maintenance operations used for the CBS.

When user appends jobs from the queue and executes, the robot moves to the color change position and waits there. The amount of time that the Robot waits depends on the CBS parameters specified. This helps user to decide new values for the CBS parameters to be set.

5.19 Virtual Fluid Device

This section describes the functionality and usage of the Virtual Fluid Device where user can get the Gun-On time and the Material consumption for a program.



Material indicates Color of paint. Each Material must be associated with a Brush Table which will be used when painting with a particular material. The information of which Brush table to be used with which Material (paint color) is specified in the *material.map* file which is created in the location specified below.

<System>

--- HOME

--- alias

program.map

material.map

Material map file contains entries as

1, Material1

2, Material2

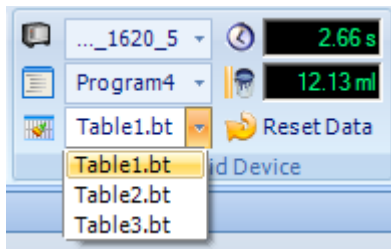
3, Material3

where 1 indicates the Brush table number used when Material1 is specified. User can specify any Brush table which is used for a particular Material. Ensure that the corresponding Brush table is present in the system.

The Material.map file is created only for systems where the Color change option has been selected.



If the Color Change option is not selected in a system, then the drop down option will list the Brush Tables present in the system as shown below



Brush tables can be created using the Edit Brush Table option from the Ribbon tab. The tables are stored in the below location in the System folder.

<System>

---IPS

--- A1Brush

Table1.bt

Table2.bt

Table3.bt

A1BTab.ndx

The folders for IPS, A1Brush and the A1BTab.ndx are created when user is activating Painting PowerPac.

If user wants to use a new material and its associated Brush Table, then it is necessary to update the Material.map and A1BTab.ndx files located in the current system.

Usage

Gun-On time is the time duration in seconds which gives the total time for which there is paint flow from the applicator while executing a program. In a program this is decided by the Brush number used in the SetBrush instructions that are used to turn-off the paint flow i.e. Material parameter value in the Brush Table is 0 for that corresponding Brush number.

Material Consumption is a value in milli litres (ml) which is the volume of Paint that will be consumed for a program. It is calculated based on the Material used and the Brush tables associated with the Material.

Description

	Item	Description
1	Create a program and Synchronize to VC and setup and execute the simulation	<p>Gun-On time and Material consumption are calculated for a program that is executing on the controller. The procedures that are required to execute can either be appended from the Job Queue or be specified from the Simulation Setup.</p> <p>If there are multiple controllers in a station, then all the controllers must be setup for simulation.</p> <p>Start the simulation and execute the procedures</p>
2	Select the Controller from the list	From the Virtual Fluid Device ribbon tab, select the controller
3	Select a Program and Material from the list	<p>All the programs that have been executed in the selected controller will be listed, from this list select a program. All the materials/Brush Tables that have been specified for the selected controller will be listed.</p> <p>By default No Material / No BrushTable will always be listed.</p>
4	Gun-On time and Material consumption	For the selected program and material the corresponding Gun-On times are calculated and displayed. The values will be calculated for the last executed program
5	Reset	Reset will clear all the values displayed and remove all programs in the list

All the programs that are executed on each controller are listed when the controller is selected. For a selected Program, user can select and check the Gun-On time and consumption for different Program and Material combinations. This functionality can be used along with the Job Queue or from the RobotStudio Simulation Setup.

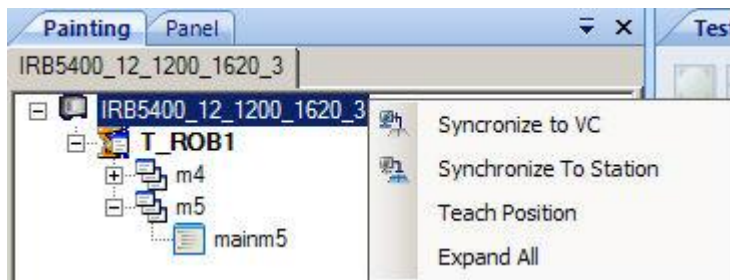
5.20 Painting Browser options

Overview

This section gives an overview of the options that are available under the Context Menu of the Browser tab in Painting PowerPac.

The context menu options listed from the Browser are particular level in the browser tree (node). Each node will have options listed that would help the user to perform certain actions pertaining to that node. These actions could affect the below child nodes.

Menu options from the Task Node



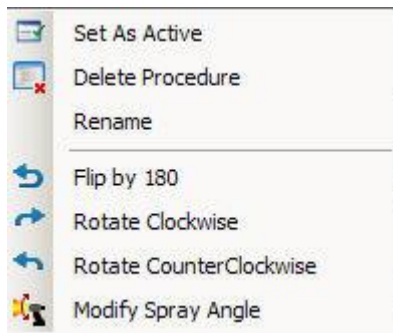
	Item	Description
1	Synchronize to VC	Synchronizes the current program to the virtual controller
2	Synchronize to Station	Opens the dialog where user can select the programs and procedures to synchronize into Station. See Synchronization for more information.
2	Teach Position	User can use this option to update the Global positions for the Painting robot.
3	Expand all	Expands all the elements in tree nodes

Menu options from Program Node



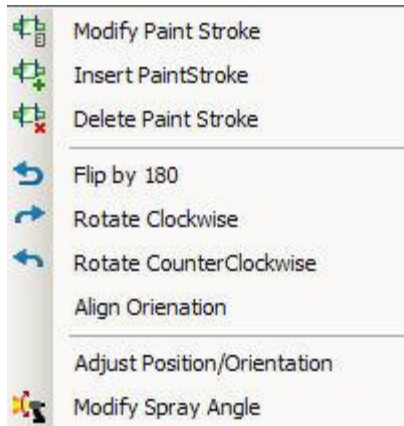
	Item	Description
1	Add Procedure	User can add a Procedure under a program. A dialog opens where the user can enter name of the procedure. The procedure hence created is by default "Set as Active".
2	Delete Program	User can Delete a program; in this case all the Procedures in the program are deleted.
3	Rename	It is possible to Rename a program. The 'mainm' procedure in the program would also be automatically renamed.

Menu options from Procedure node



	Item	Description
1	Set as Active	This option is to select the procedures to which paintStrokes have to be appended. This applies if there are multiple procedures in a program.
2	Delete Procedure	It is possible to delete a single procedure and all the paintstrokes under it.
3	Rename	Renames a procedure.
4	Flip by 180	Rotates all the targets in the procedure by 180 deg about the Z-axis.
5	Rotate Clockwise	Rotates all the targets in the procedure by 90 deg in clockwise direction about the Z-axis.
6	Rotate CounterClockwise	Rotates all the targets in the procedure by 90 deg in Counter-clockwise direction about the Z-axis.
7	Modify Spray Angle	Opens dialog where user can modify the spray angle. See Spray Angle for more information

Menu options from PaintStroke node



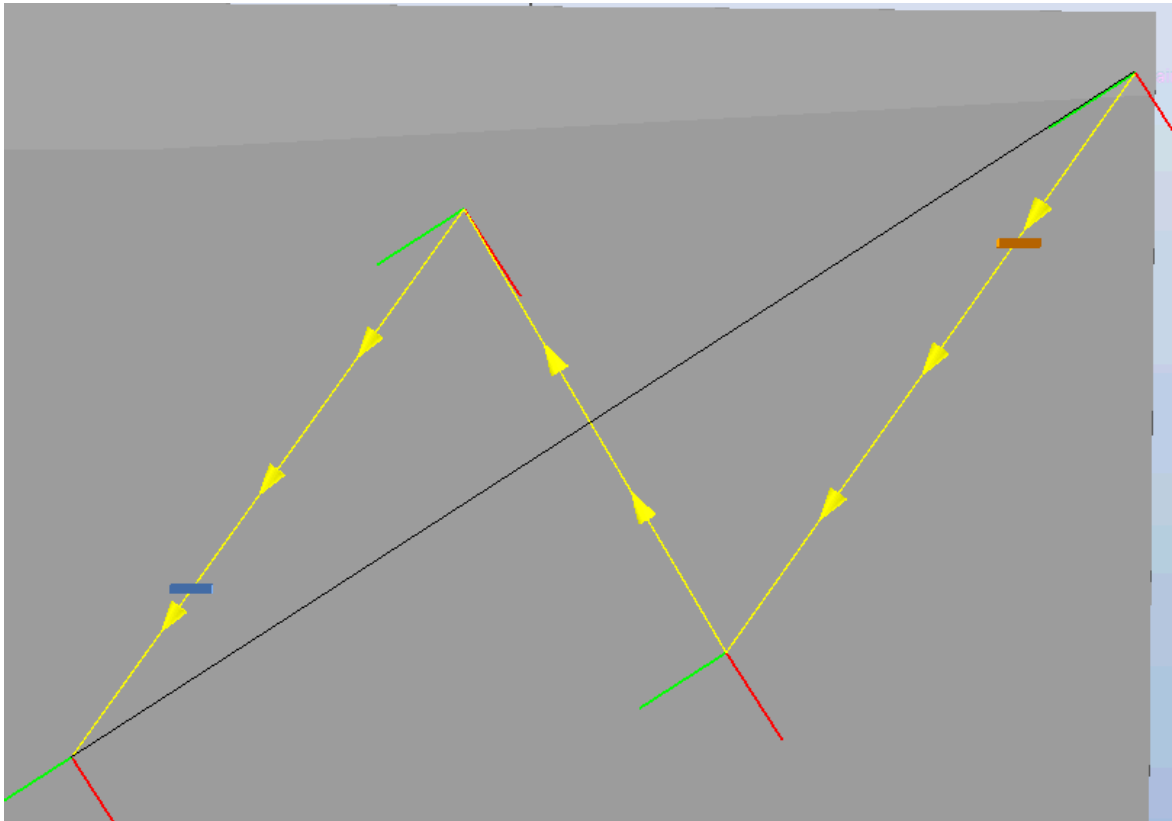
	Item	Description
1	Modify PaintStroke	User can add a Procedure under a program. A dialog is provided where the user can enter the name. User should ensure that the name of the procedure is valid and has a prefix "main"
2	Insert PaintStroke	User can Insert a PaintStroke. The procedure is similar to creating new PaintStrokes, however only 1 PaintStroke can be inserted.
3	Delete PaintStroke	User can Delete a PaintStroke; in this case all the instructions under the PaintStroke are deleted.
4	Flip by 180	Rotates all the targets in the PaintStroke by 180 deg about the Z-axis.
5	Rotate Clockwise	Rotates all the targets in the PaintStroke by 90 deg in clockwise direction about the Z-axis.
6	Rotate CounterClockwise	Rotates all the targets in the PaintStroke by 90 deg in Counter-clockwise direction about the Z-axis.
7	Align Orientation	Aligns the orientation of all the targets in the PaintStroke with Y-axis to point in the direction of line from Start event to end event.
8	Adjust Position and Orientation	User can Offset the Paintstroke or rotate the targets in the paintstroke along the local axis.
9	Modify Spray Angle	User can modify the spray angle for all the targets in the paintstroke.

Align Orientation

Align Orientation option sets the same orientation to all the RobTargets in the PaintStroke. The orientation of the RobTargets is such that the Y-axis is pointing the direction from the Start Brush event to the Ending Brush event.

This is illustrated in the picture below. The *black* line showing the direction from the Start and the End Event.

The Y – axis of all RobTargets is oriented in the direction of the line.



Menu options from PaintL Instruction nodes



	Item	Description
1	Modify Instruction	User can modify instruction parameters that are passed into the program.
2	Insert PaintL	User can add an instruction after a PaintL instruction.
3	Insert Event	User can add an event on a PaintL instruction. See Insert Event for more details
4	Delete Instruction	User can delete an instruction. If there are <i>SetBrush</i> instructions associated with the <i>PaintL</i> instruction, then they are deleted as well.
5	Flip by 180	Rotates all the targets in the PaintStroke by 180 deg about the Z-axis.
6	Rotate Clockwise	Rotates all the targets in the PaintStroke by 90 deg in clockwise direction about the Z-axis.
7	Rotate CounterClockwise	Rotates all the targets in the PaintStroke by 90 deg in Counter-clockwise direction about the Z-axis.
8	Adjust Position and Orientation	User can Offset or rotate the corresponding target in the paintstroke along the local axis.
9	Modify Spray Angle	User can modify the spray angle for all the corresponding targets in the paintstroke.

Menu from SetBrush Instruction node

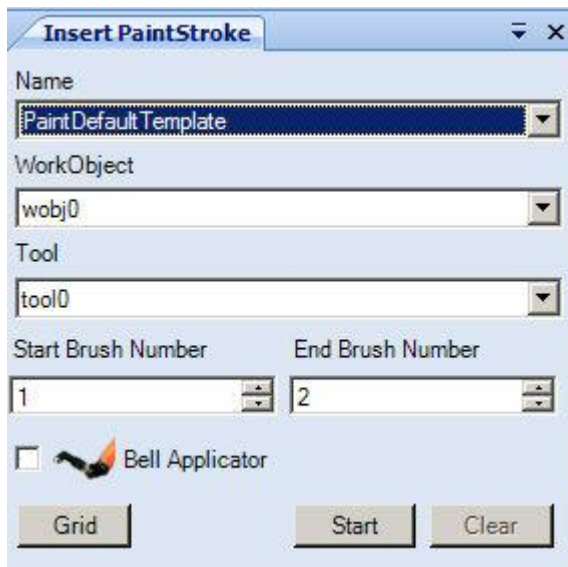


	Item	Description
1	Modify Event	User can modify the Event parameters such as the Brush number, Applicator number and change the trigger position. The event is also modified graphically.
2	Delete Event	User can delete an Event using this option.

5.21 Insert PaintStroke

User can insert a Paintstroke between two PaintStrokes. The dialog for this is similar to the Create PaintStroke dialog. The new paintstroke is inserted below the selected PaintStroke.

NOTE! User can insert one PaintStroke at a time.

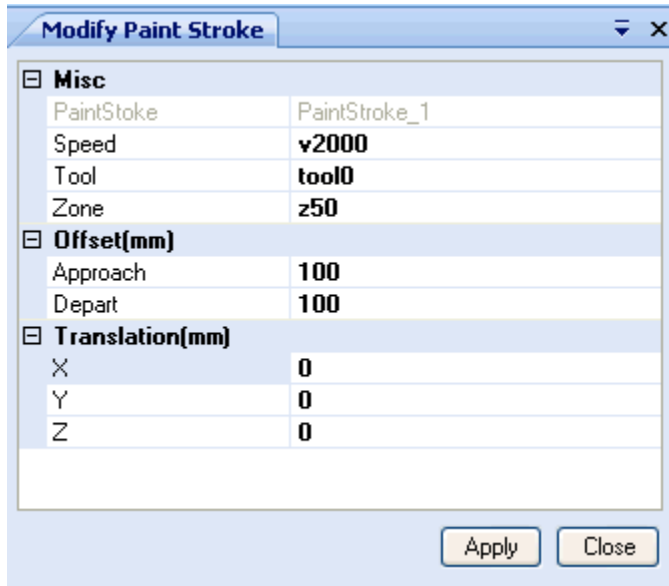


The screenshot shows a dialog box titled "Insert PaintStroke". It contains the following fields and controls:

- Name:** A dropdown menu with "Paint Default Template" selected.
- WorkObject:** A dropdown menu with "wobj0" selected.
- Tool:** A dropdown menu with "tool0" selected.
- Start Brush Number:** A numeric input field with the value "1".
- End Brush Number:** A numeric input field with the value "2".
- Bell Applicator:** A checkbox that is currently unchecked, with a small icon of a bell applicator to its left.
- Buttons:** Three buttons at the bottom: "Grid", "Start", and "Clear".

5.22 Modify PaintStroke

User can modify the Paintstroke for the parameters in the PaintL instruction. The dialog is as shown below. User can change any of these parameters and click on *Apply*. The change is reflected in all the Paint instructions under the PaintStroke



User can change the *Approach* and *Depart* distance for the selected PaintStroke. When user Translates the PaintStroke, then all the instructions in the PaintStroke are offset by the specified distance with reference to Global frame. The SetBrush trigger positions will also be updated.

5.23 Delete PaintStroke

User can select a PaintStroke and delete it. All the *PaintL* and *SetBrush* instructions below the PaintStroke are deleted.

NOTE! If there are no procedures in RobotStudio which are referring to the same Targets, then the Targets are also deleted.

5.24 Delete Instruction

User can select and instruction and delete it. If the instruction is a *PaintL* and has associated *SetBrush* events, the events are re-positioned.

Example:

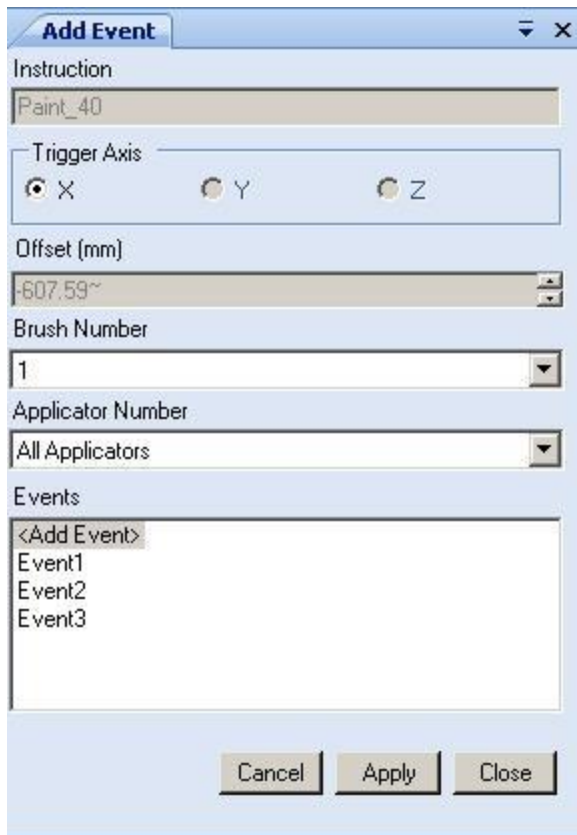
```
PaintStroke_1
  PaintL Target_20
  SetBrush 2/Y:= 75;
  SetBrush 5/X:= -150;
  PaintL Target_30
  PaintL Target_40
  SetBrush 2/Y:= 75;
  PaintL Target_50
```

Deleting *PaintL Target_30* would also delete *SetBrush 5/X: = -150* and *SetBrush 2/Y:= 75*

The following events, i.e *SetBrush 2/Y:= 75* are re-positioned based on the new path.

5.25 Insert Event

User can Insert an *Event* on a *PaintL* instruction. A dialog opens up as below



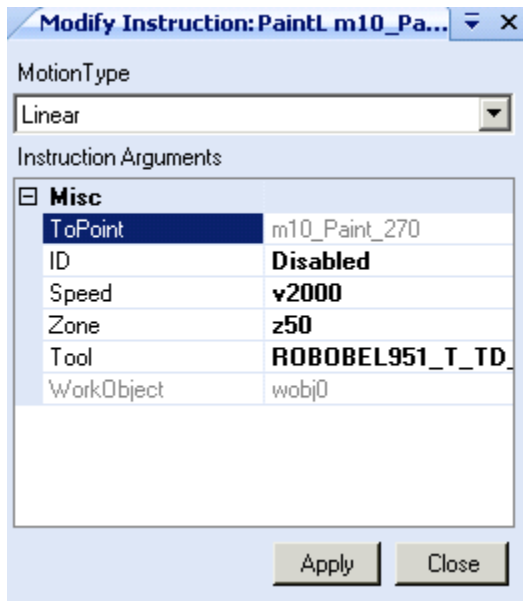
To Add an event follow these steps

1. Right click on the *PaintL* instruction and select *Insert Event*. The dialog shown above opens. The instruction is highlighted in the graphical window.
2. The Major axis is automatically calculated.
3. Select the Brush Number from the drop down menu
4. Select the Applicator.
5. Click on *Add Event* from the Events menu option and then select graphically the event positions on the instruction. The events offset values are calculated and displayed in the menu.
6. Click on *Apply*, then the events is inserted above the *PaintL* instruction.

NOTE! A maximum of 10 events can be added in a *Paint* instruction and the instructions are automatically ordered based on the path direction when applied to the *PaintStroke*.

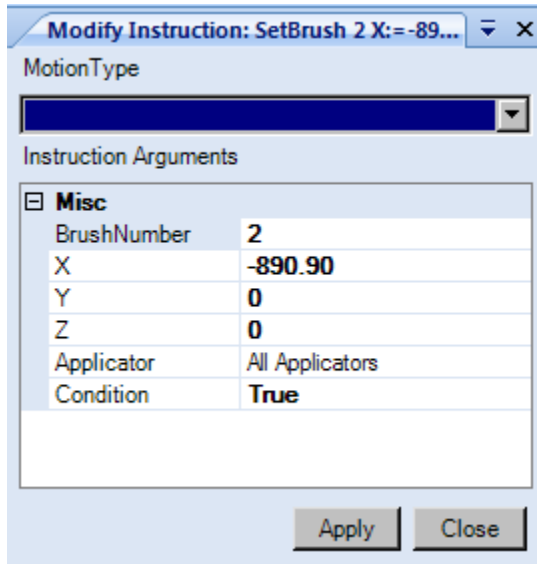
5.26 Modify Instruction

User can select and modify an instruction. The dialog is as shown below.



User can make the change and click on *Apply*. The changes are reflected in the instruction and can be verified from RobotStudio “Home” tab.

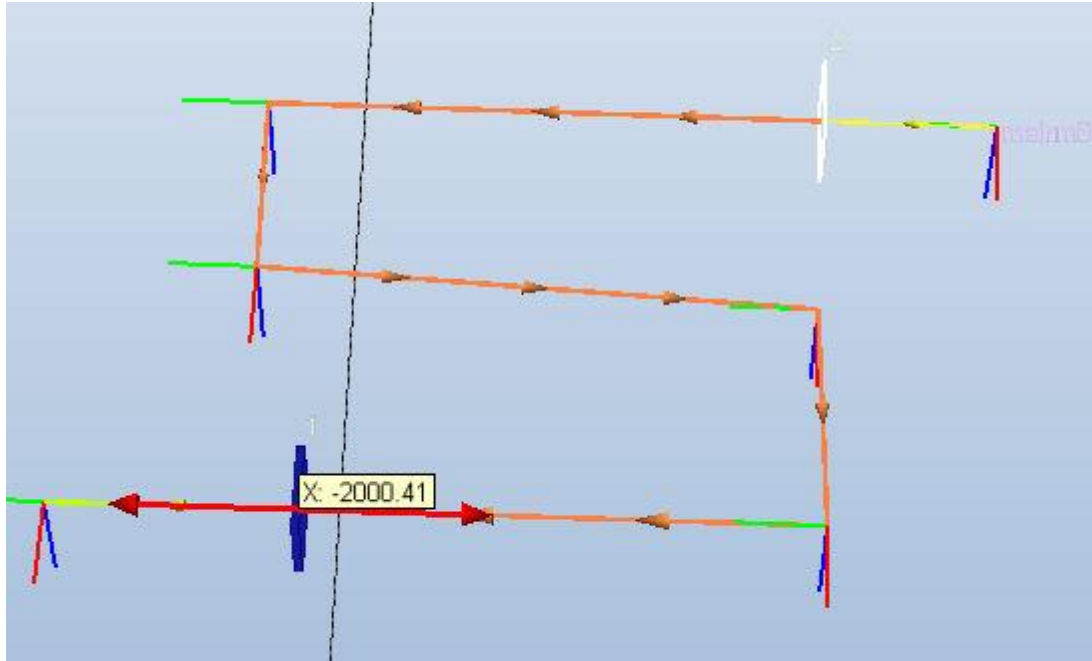
5.29 Modify and Delete Event



The SetBrush event attributes can be modified by following the steps

1. Select the event and right click and select *Modify Event*, the dialog shown above opens. The event is also highlighted in the graphical window.
2. Enter the offset value for the major axis and click on *Apply*. The event position is re-positioned. If the event position is not reachable, then the Event does not re-position.
3. Brush number and Applicators can also be selected and modified similarly. When the Brush number is changed, then the path color changes corresponding to the information in the Brush specification.
4. The Conditional argument value 'True' for the SetBrush event reflects that the event is triggered. The argument 'False' indicates that the event will not be triggered even if the robot path passes the trigger point.

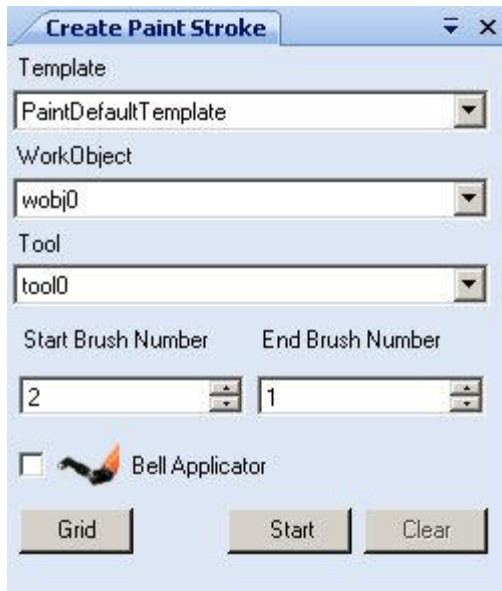
It is also possible to modify the event position graphically, when user clicks on the SetBrush instruction in the browser window, then the modification arrows are activated in the graphics. User can click and drag on the arrow to re-position the event. The value is automatically updated in the instruction.



User can delete an event. The event is removed from the Browser and the graphical window.

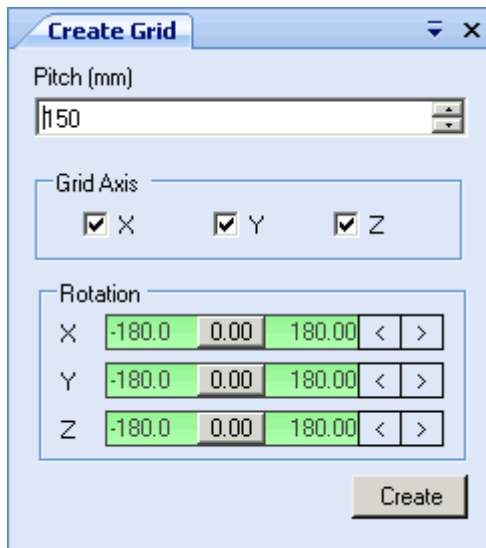
5.28 Create Grid

User can create a grid view on the surface on which paint strokes are to be created. This functionality will help the user to create parallel paths when using the *Create Manual PaintStroke* functionality and is accessible from the same dialog. When creating Paint strokes for models with intricate surfaces, this feature will help the user to position the targets more accurately.



Usage

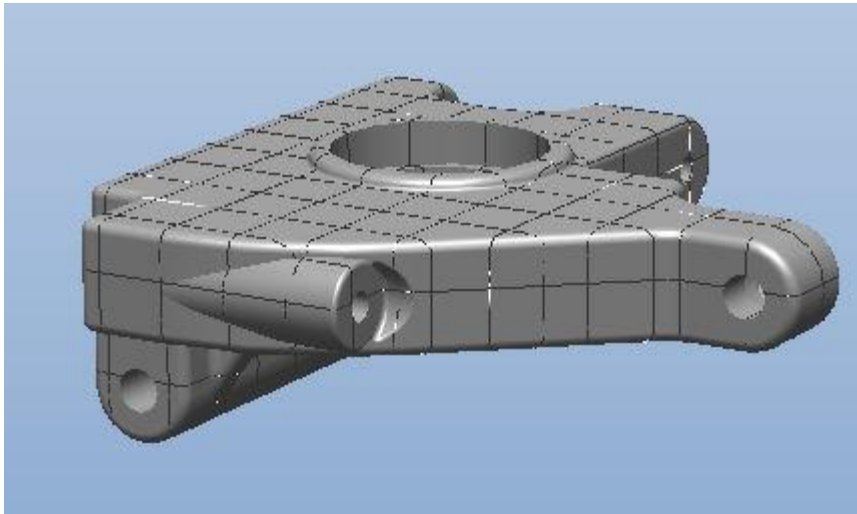
When user clicks on the Create Grid option, the dialog opens in the right side of the window.



Workflow

	Item	Description
1	Select the surfaces or parts from the graphical window	User can select either surface or part. Multiple selections can be done by holding down the Shift key and pressing the clicking to select graphically.
2	Specify the Pitch	User can specify the Pitch value which defines the distance between each path.
3	Click on Create	The grid is created on the selected surfaces / parts. User can visualize the grid as a 3-D frame of the part. The grid of the model is created based on the world coordinates. By default all the three Grid axes are selected. User can deselect whichever is not suitable or is not applicable.
4	Rotate the Grid	It shall be possible for user to rotate the grid around each of x, y & z axis. After user has specified the rotation values, user can click on Create and then check the visualization.

Create Grid functionality will be useful when the workpiece is intricate, for example as shown below. In these types of CAD models the grid will show the reference lines which can be used to ensure parallel paths.



When user selects another set of surfaces and creates a Grid, then the previous grid will be deleted. When the Create Manual PaintStroke dialog is closed, all the grids are deleted. User can also *Show / Hide* the grid using the option present on the ribbon tab.

5.27 Spray Angle

Spray Angle is the angle made by the Tool when moving along in the direction of the path as shown below. A positive value indicates that the Tool must be oriented in the direction of the path and a negative value the opposite. Usually while painting, the applicator is slightly tilted in the direction of the path to blow away any dust particles on the workpiece.

This option is available as a context menu option under the Program, PaintStroke and PaintL instruction nodes.



Usage

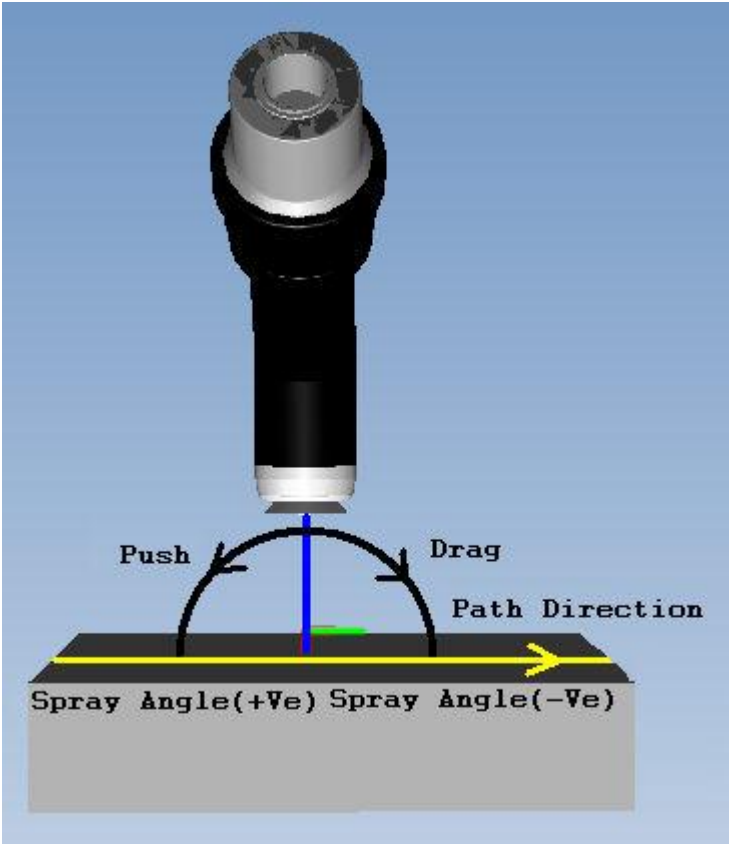
Description

	Item	Description
1	Create Paintstrokes from Painting PowerPac	Create the paintstrokes using either Manual PaintStokes or Auto Create PaintStroke option. Ensure that the targets have their Z - axis pointing normally into the surface
2	Select the Modify Spray Angle option from the PaintStroke node and specify a positive value in degrees. Then click on Apply	All the instructions associated with the corresponding PaintStroke are modified such that their Z - axis is pointing slightly in the direction of the path.
3	Modify the value again and click on Apply	The angle is always relative to the current target orientation
4	Enter a negative value	The angle is rotated such that it is pointing in the opposite direction of the path.

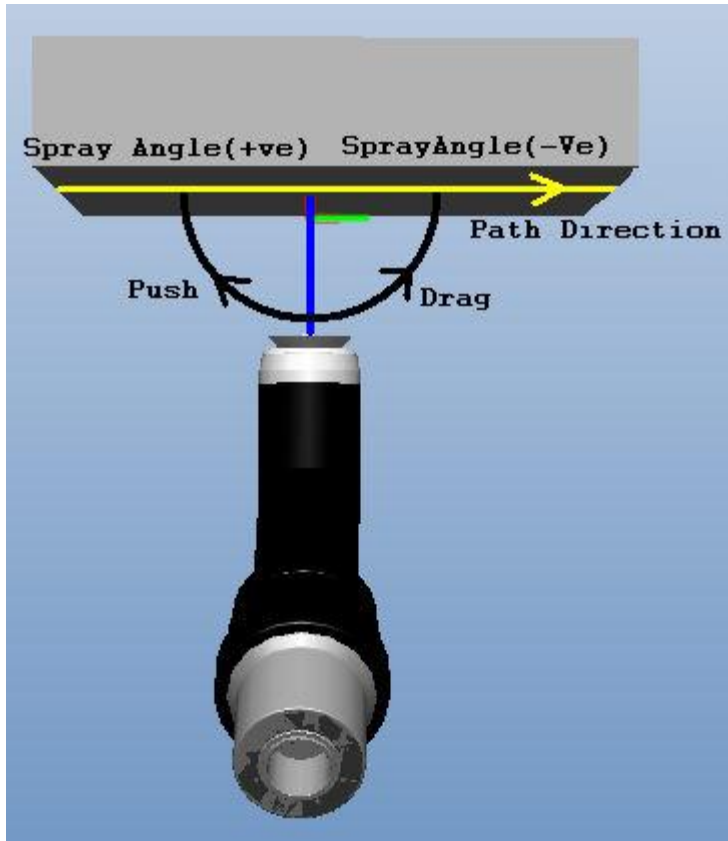
Irrespective of how the targets are oriented, a positive value always indicates that the Tool is pointing in the direction of the path i.e Push. If the tool is pointing in the opposite direction of the path, then it is Drag.

Example - If the targets are pointing Normal to Surface, but in the opposite direction, then specifying a Positive value for the Spray angle aligns it in the direction of the path.

These conditions are shown below



Tool pointing downwards



Tool pointing upwards

In the above scenario, specifying a positive value would rotate the tool such that it is in **Push**.

Also this functionality can be used in case the orientation of targets of targets after Generating a path on a surface are not uniform and some are pointing in the opposite direction, then use this functionality to rectify these targets by specifying a Spray Angle of 180 degrees.

NOTE! When user specifies the Spray Angle and then continues to click on *Apply*, the targets continue to rotate in a specific direction such that the Z - axis of the target is pointing towards or away from the direction of the path. In this process when the Z- axis moves above the path, then the targets' properties change such that for the same Spray Angle, the movement shall be in the opposite direction as described in the above pictures. Hence in order to continue to rotate in the earlier direction, user must change the sign of the Spray Angle once it crosses the plane of the path.

5.30 Adjust Position and Orientation

User can modify the position and orientation of either one or all PaintStrokes in a Program. The functionality is available under PaintStroke and PaintL instruction levels.

The dialog opens as shown below



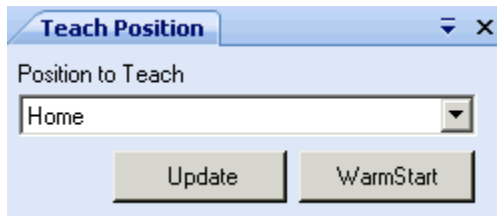
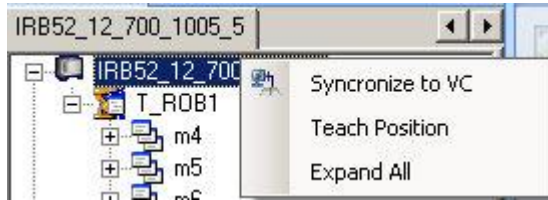
Usage

	Item	Description
1	Offset Position	<p>User can offset paintstroke/paintstrokes or instructions. The paintstroke is offset by the specified values from the current with the Global reference frame.</p> <p>The global reference frame can be visualized in the graphical window of RobotStudio.</p> <p>When paintstroke is offset, then all the associated SetBrush instructions are also updated such that they reflect the current values with respect to the WorkObject.</p>
2	Rotate	<p>All the targets in the PaintStroke/PaintStrokes are rotated around selected axis. The rotations are relative to the current Local position. Both the Offset and Rotate changes are committed if user clicks on Apply. If user clicks Cancel, then rotations come back to original values.</p>

NOTE! When user enters any value in any of the dialogs, then the corresponding targets are modified graphically to indicate the new positions to the user. The new values are applied only when user clicks on Apply.

5.31 Teach Position

This option is given to user to teach the global position variables present in the Paint robot controller. This option is available from the context menu option under the System.



User can update the positions for

1. Home
2. Material
3. Ready
4. User

Steps to update the positions

	Task	Description
1	Select the Position	Select one of Home, Material, Ready and User positions
2	Jog the Robot to the corresponding position and click on Update	The current Robot position will be recorded into the Global variable for the corresponding position in the system.
3	Warm Start	The variables are of the Persistent type and are updated only when the user has warm-started the controller.

HomePos and *CCPos* are pre-defined programs in the Paint Controller. User can append and check these programs from the Job Queue.

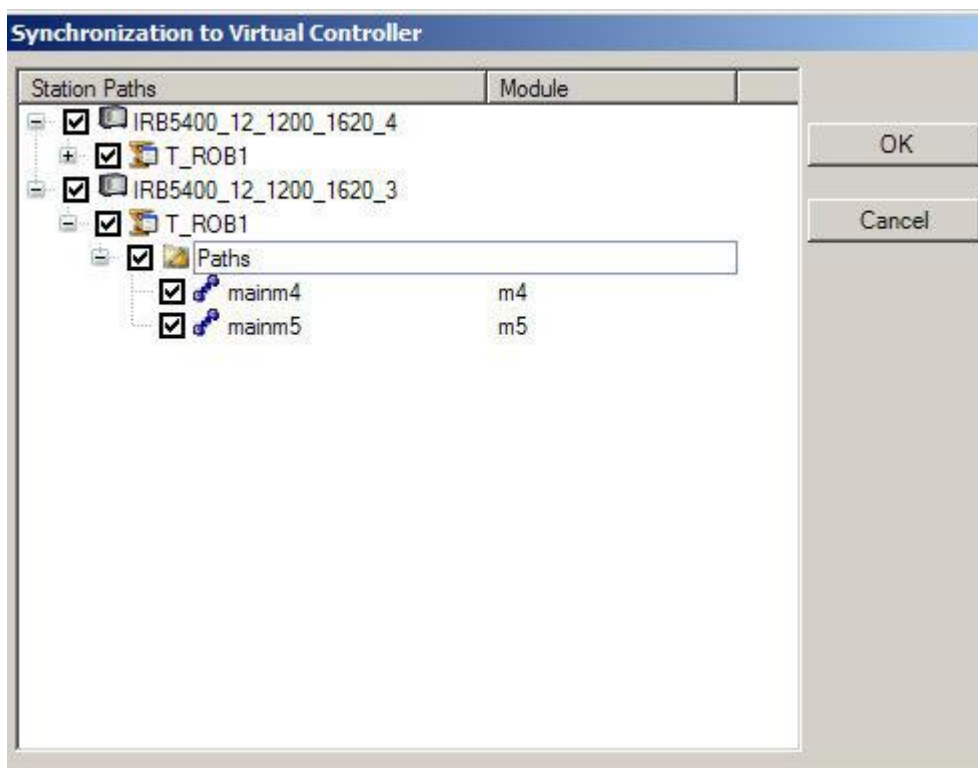
5.32 Synchronization

User can perform Synchronize to Virtual Controller (VC) and to Station from Painting PowerPac.



Synchronize to Virtual Controller

This opens a dialog where user can choose the procedures to be synchronized to the Virtual Controller from all the systems in the station.



All the selected procedures will be synchronized to VC.

In Painting systems, the RobTargets are usually declared as LOCAL. Hence there could be several targets by the same name in different modules. This feature is also available in Painting PowerPac where the RobTargets created are declared as LOCAL. RobotStudio supports unique naming of RobTargets. In case of LOCAL targets, the name of the RobTarget is prefixed with the corresponding module name to distinguish them.

Ex: For modules m4 & m5 the corresponding targets are displayed as

m4/Paint_10 m5/Paint_10
m4/Paint_20 and m5/Paint_20

After synchronizing to VC, the target is created as LOCAL const Paint_10. Similarly when a paint module is synchronized to Controller, the targets are associated with module names as specified above.

The generated RAPID code also has information about the

- Workpiece Name
- Workpiece Position
- Brush Specification

These are uploaded as Datatypes into the RAPID program. User can refer to this information when setting up the Paint cell. Also when user is opening a Paint program from PowerPac with the above information, then the Brush would be automatically selected and the workpiece positioned at the defined position in RobotStudio.

Ex:

```
MODULE m4
  CONST string m4_WorkPiece:="Mazda MX5";
  CONST string m4_WorkPiecePos:="[0,2.12,0],[0,0,0]";
  CONST string m4_BrushSpecification:="Brush1";

  LOCAL CONST robtarget Paint_10:=[[1749.98,2930.317.92],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_20:=[[1174.75,2925.72,333.54],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_30:=[[957.62,1640.81,853.48],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_40:=[[343.98,2386.23,594.17],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_50:=[[41.91,2293.59,544.97],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_60:=[[402.05,2387.09,469.97],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_70:=[[172.04,1980.45,524.26],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_80:=[[175.85,1897.09,573.16],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_90:=[[934.24,2912.63,228.14],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];
  LOCAL CONST robtarget Paint_100:=[[1607.1,2886.01,152.97],[6.12303176911189E-17,6.12303176911189E-17,1.6.12303176911189E-17],[0,0,0,0],[9E9,9E9,9E9,9E9,9E9,9E9]];

  PROC mainm4()
    PaintL Paint_10,v2000,z50,tool0\WObj:=wobj0;
    SetBrush 2\X:=1650;
```

```
PaintL Paint_20,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_30,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_40,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_50,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_60,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_70,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_80,v800,z100,tool0\WObj:=wobj0;  
PaintL Paint_90,v800,z100,tool0\WObj:=wobj0;  
SetBrush 1\X:=1810;  
PaintL Paint_100,v800,z100,tool0\WObj:=wobj0;
```

```
ENDPROC
```

```
ENDMODULE
```

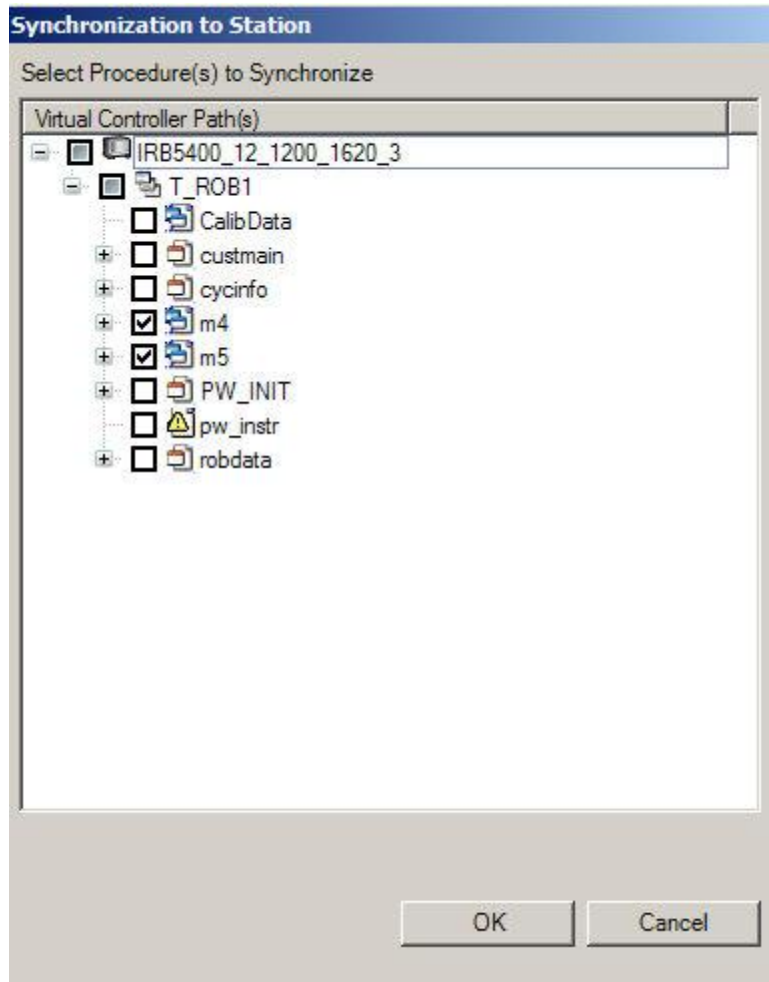
NOTE! RobTargets declared as LOCAL can only be created from Painting PowerPac.

If a target created from Painting PowerPac is used in another procedure with the station, then the target will be internally converted to an In-Line target when the procedures are Synchronized to Virtual Controller.

NOTE! See Release notes for known limitations with LOCAL RobTargets usage in RobotStudio.

Synchronize to Station

This opens a dialog where user can choose the procedures to be synchronized to RobotStudio station from Offline.



The selected procedures will be synchronized to Station. If user is synchronizing procedures existing in Painting tab, then all the RobTarget names will be pre-fixed with the information of the corresponding module. This ensures that the target names are unique and are not overwritten when multiple modules having the same LOCAL RobTarget names are synchronized.

NOTE!

- If any new procedures have to be synchronized to Station and reflected in Painting tab, then user has to use [Load Module](#) option in Painting PowerPac.
- When a Program and its corresponding procedures are synchronized into the Virtual Controller, then the resulting RAPID file is saved in the corresponding System folder. This is because the RAPID modules in the System are loaded into RobotStudio during execution process from the Paint *main* procedure.
- If a target created from Painting PowerPac is used in another procedure in the station, then the target will be internally converted to an In-Line target when the procedures are Synchronized to Virtual Controller.