User guide
H-1000-0211-03-A

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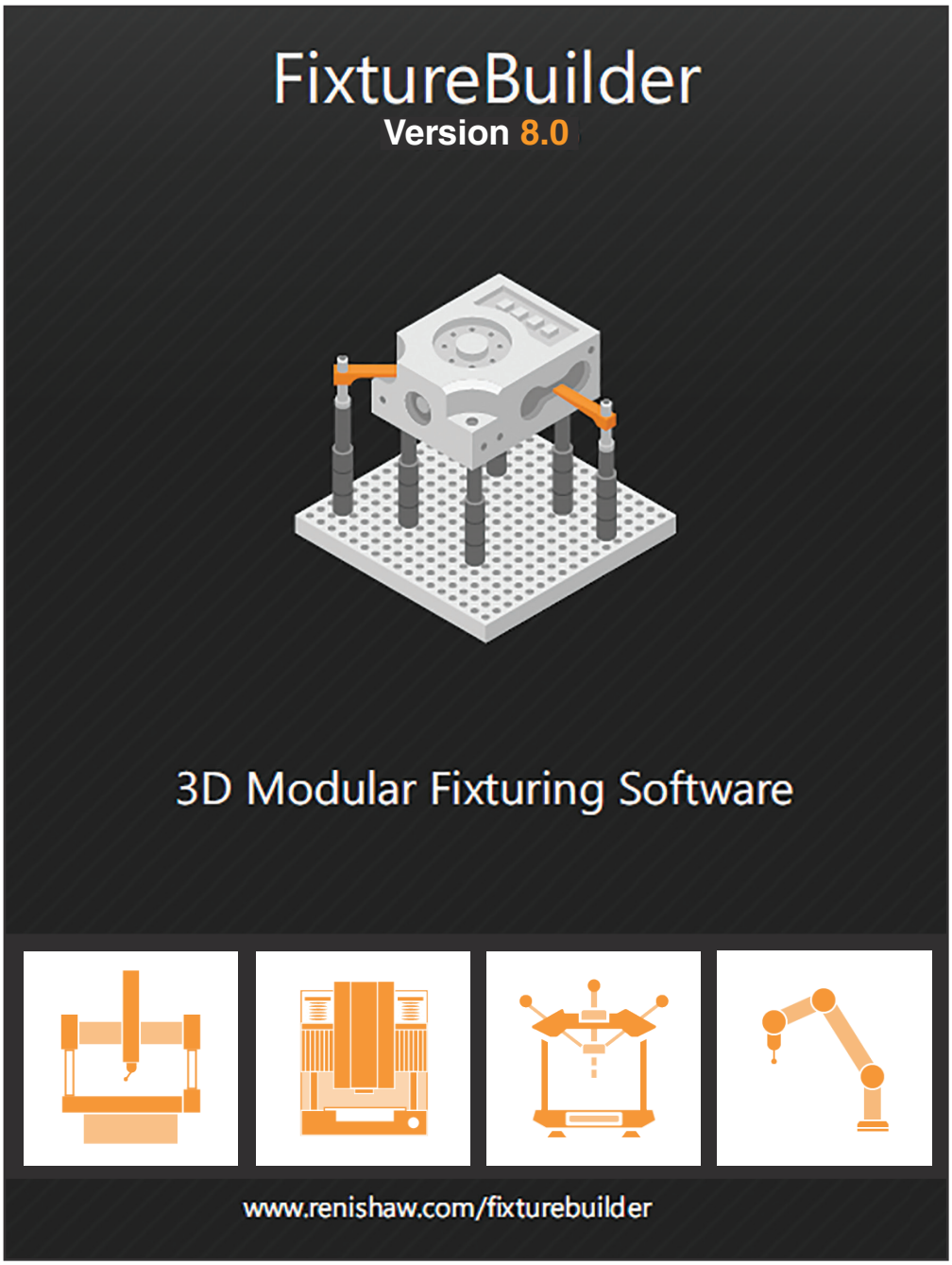
FixtureBuilder software



Trade marks

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Renishaw plc warrants its equipment provided that it is operated exactly as defined in associated Renishaw documentation.

Renishaw part no:	H-1000-0211-03-A
First issued:	06.2016
Revised:	06.2020

Contents

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1. FixtureBuilder introduction

FixtureBuilder is a 3D CAD package that enables users to create, edit, document and export a metrology fixture set-up for use in offline programming. It has been created with software provider IronCAD. The software also automatically generates a “Build It” document which includes:

- Comprehensive build instructions on how to assemble the fixture.
- Preview images of how the fixture should look.
- A bill of materials (BOM) to aid the user with parts usage and ordering.

Note: The package requires a basic understanding of fixturing principles and also a basic knowledge of Renishaw’s fixturing kits.

For support, please contact:

fixturebuildersupport@renishaw.com

2. Fixturing principles

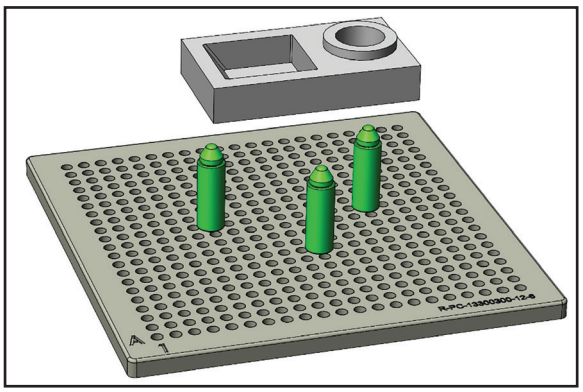
With any fixturing application, it is important to remember the key fixturing principles. These will ensure that any fixture built will be stable enough and correctly designed to ensure that repeatable measurements can be taken.

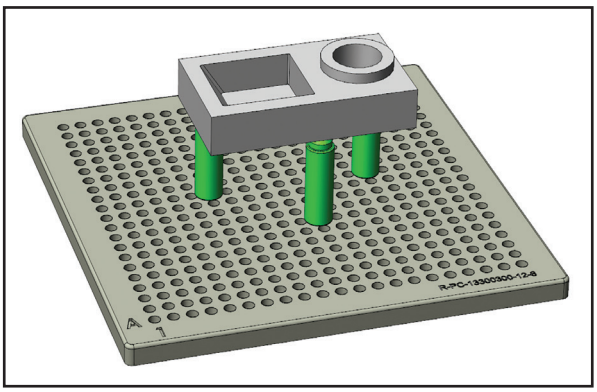
3-2-1 Principle

This principle outlines the core procedure for any fixture.

1. Three points of support in Z axis (primary datum).
2. Two points to fix the X axis (secondary datum).
3. One point to fix the Y axis (tertiary datum).

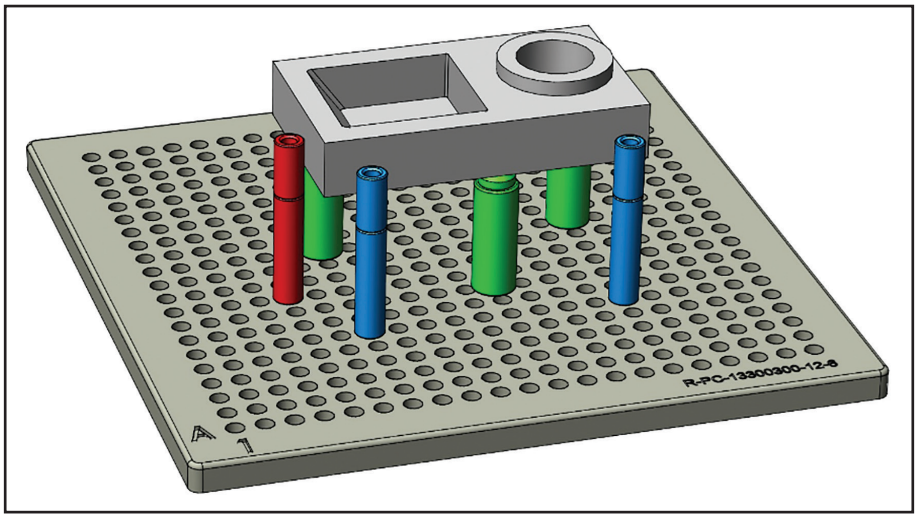
First, the part must be supported by three contact points (green standoffs). This fixes the Z movement of the part whilst ensuring it has a stable base to rest on.





NOTE: More than three points can be used for very large, heavy parts.

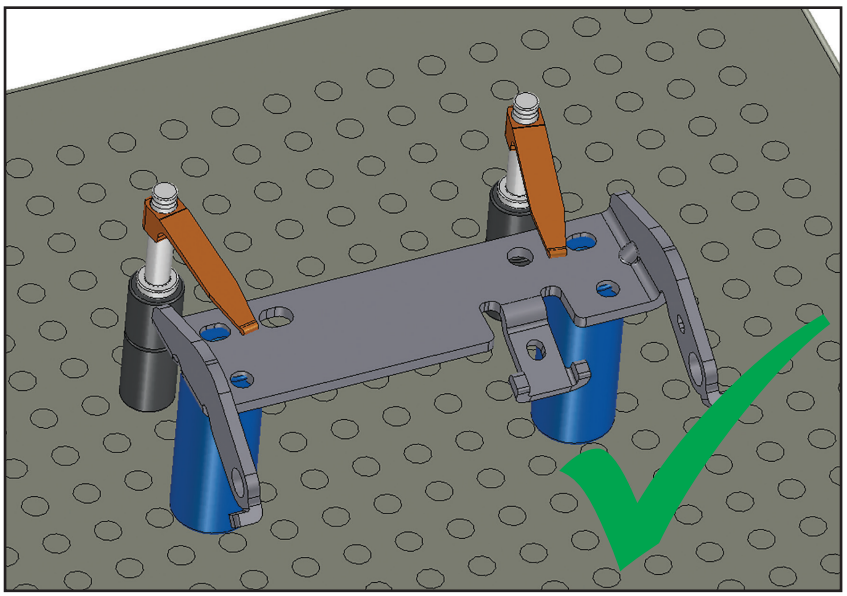
The part must then be secured in the X and Y axes to stop translation and rotation. To do this, two contact points need to be created to fix the Y movement (blue standoffs), and finally one point is needed to fix the X movement (red standoff).



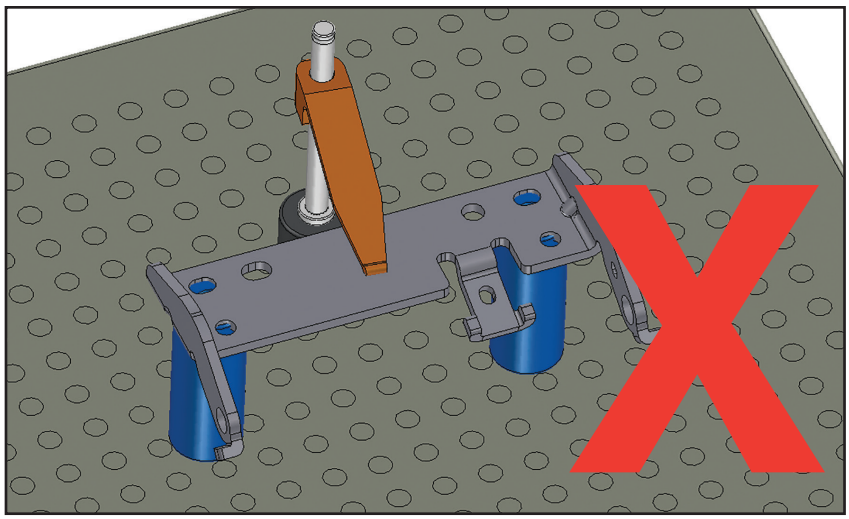
Clamping

Clamping ensures the part does not move under inspection.

When clamping, it is recommended to clamp above a supporting standoff. This not only ensures the part is not deformed by the clamping, but it also ensures that the part is rested on its datum features.



Clamping above standoffs is recommended.



Clamping between standoffs should be avoided.

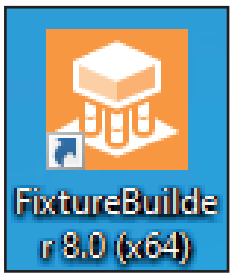
Adjustability

Note: Adjustable components should be reduced where possible as they can reduce the reproducibility of the fixture.

Using adjustable components is a great way of building a fixture that exactly fits the part being inspected. If you are going to be breaking down and rebuilding the fixture frequently, it is advised that you keep these to a minimum as they are hard to reproduce in exactly the correct positions. However, adjustable height standoffs can be measured with a vernier calliper to check and record heights.

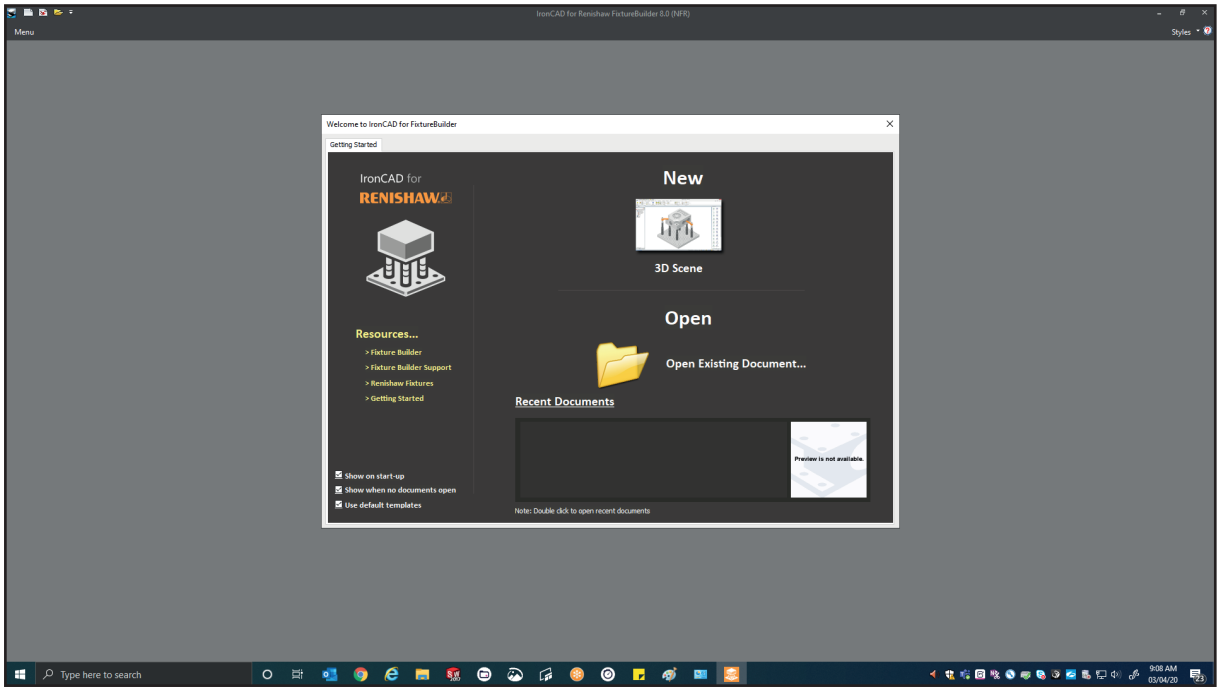
3. Getting started

FixtureBuilder is accessible via the desktop icon; click on it to launch the application.

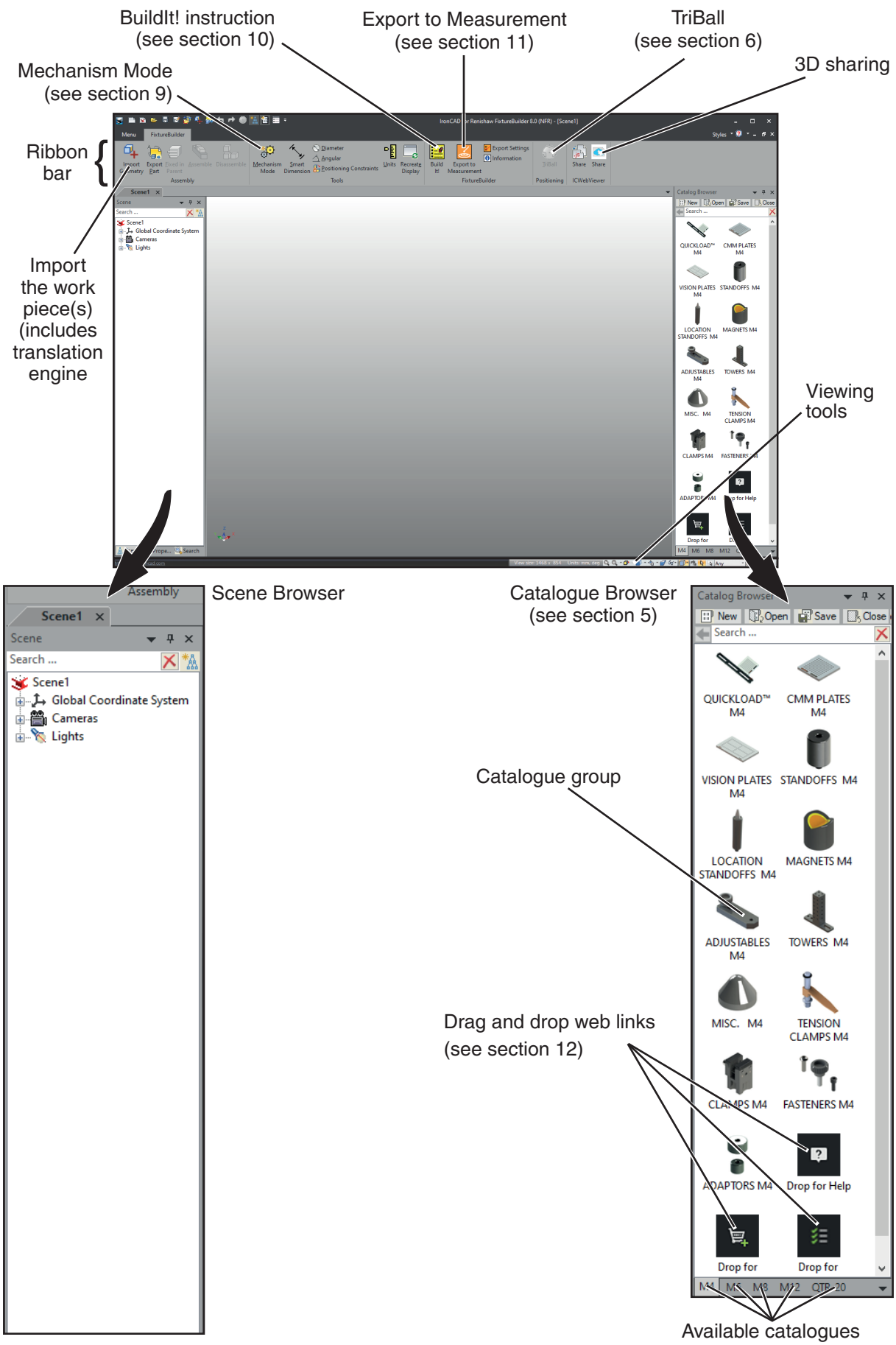


There are then two choices:

1. Under **New**, click the icon to launch a new blank scene. Then select the scene style.
2. Click **Open** to search for a previously configured FixtureBuilder file.



4. FixtureBuilder scene navigation

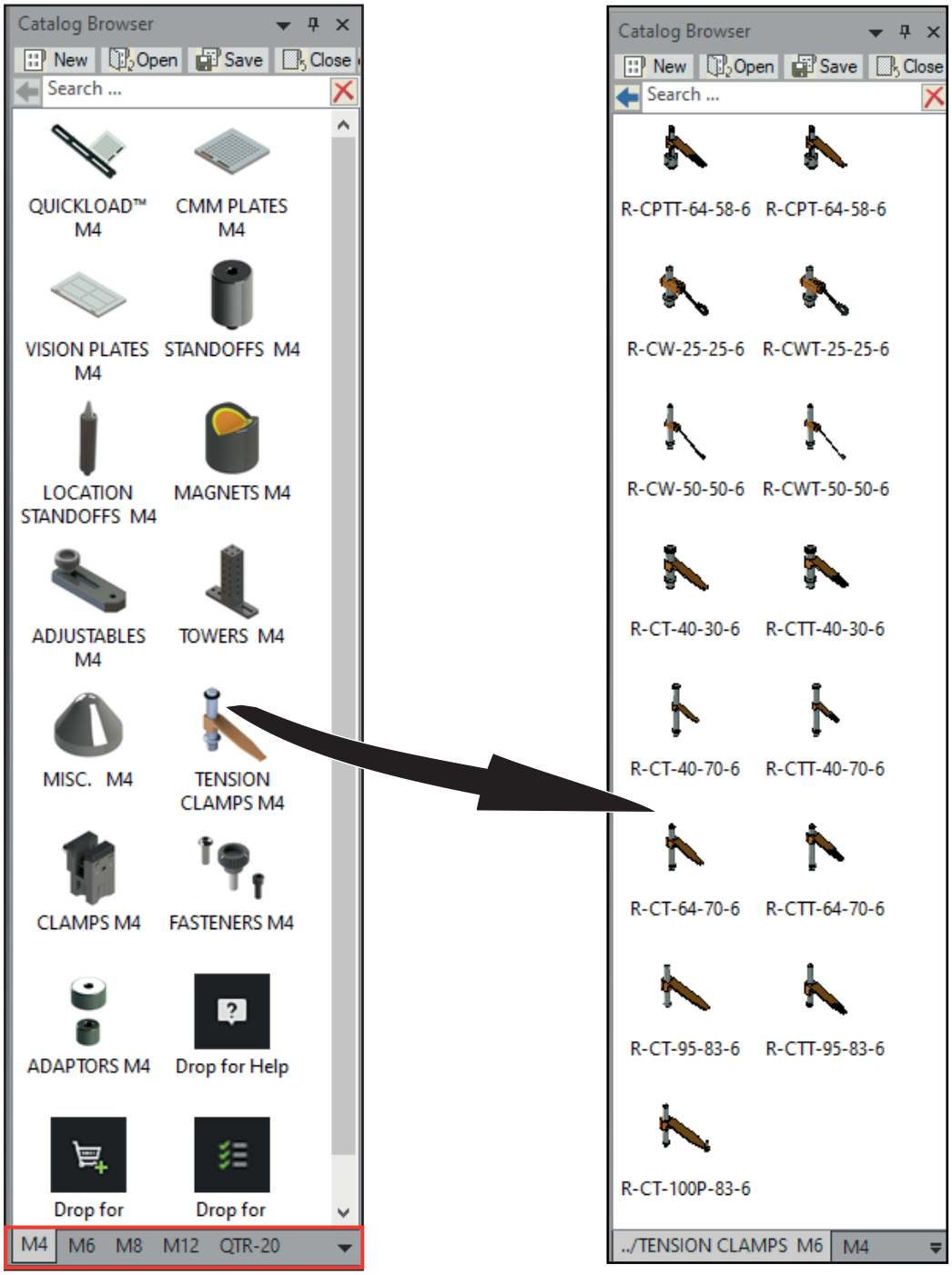


5. Catalogue Browser

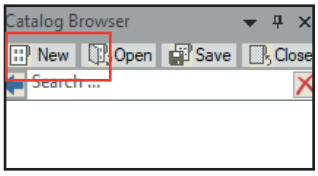
The **Catalogue Browser** contains the full range of modular fixturing components across M4, M6, M8, M12 and 1/4-20 (QTR-20) thread sizes. The different catalogues can be accessed by clicking the tabs at the bottom of the **Catalogue Browser**, as shown in the image below.

Note: Always use the correct threaded components with the base plate, otherwise the auto snap function will not work (for example, use M4 components with M4 plates).

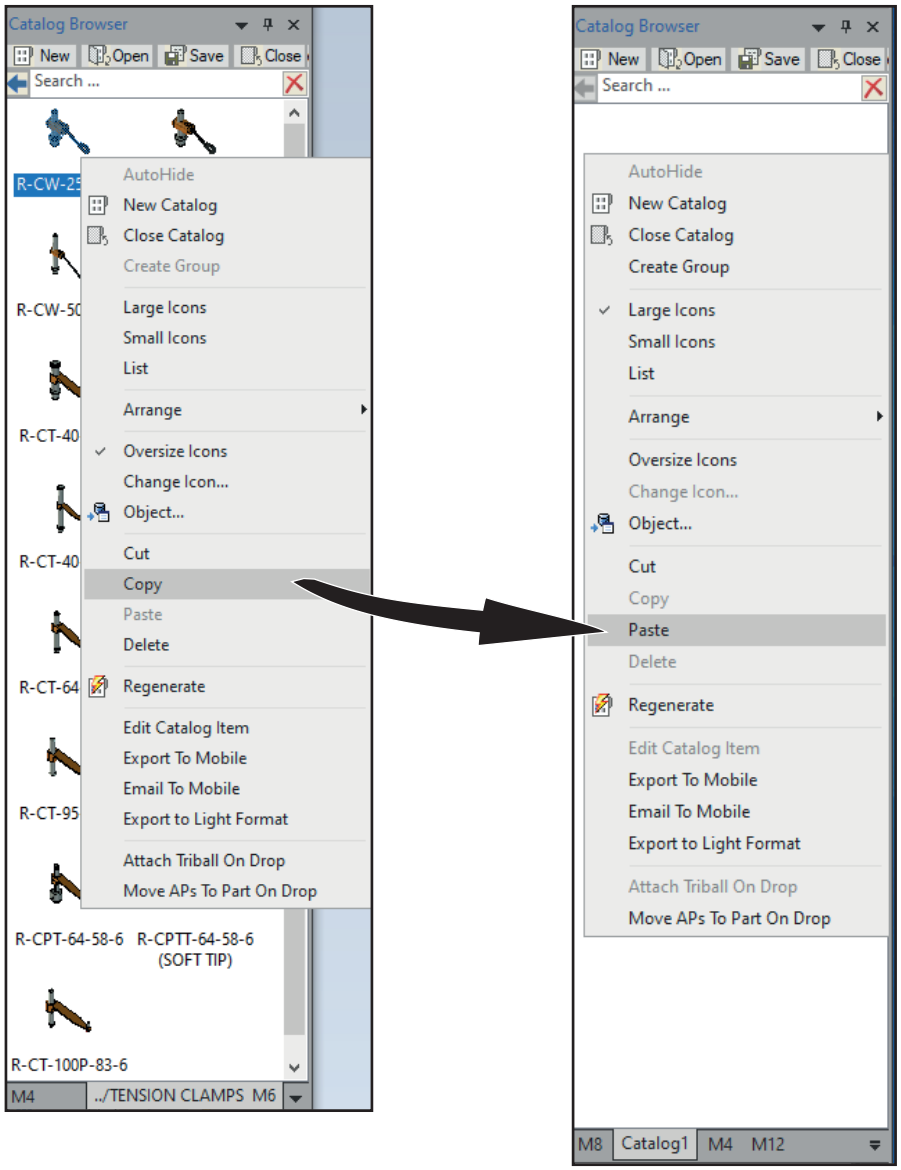
To enter into a specific catalogue (clamps, adjustables, standoffs, and so on), double-click on the catalogue icon to open that catalogue set. To go back, click the icon at the top of the **Catalogue Browser**.



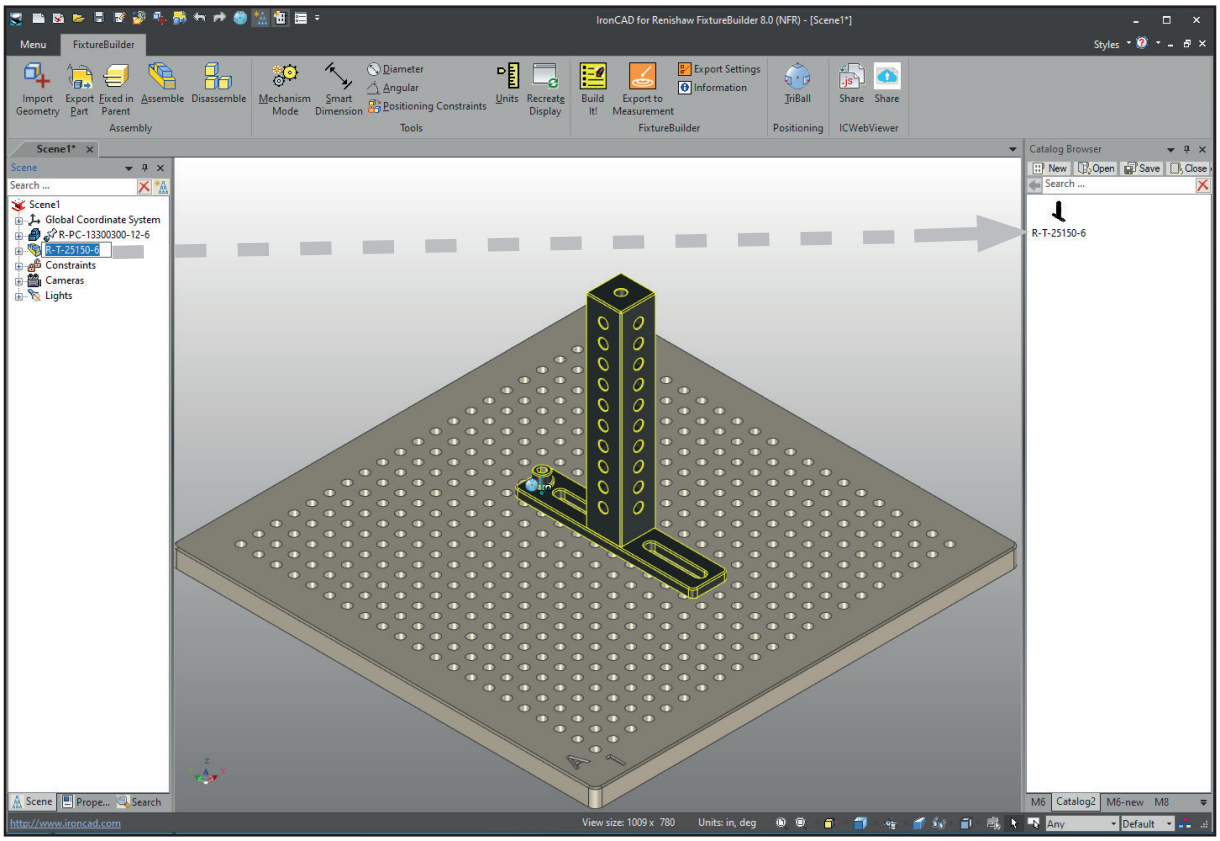
The **Catalogue Browser** can also be customised with specific components (for example, to suit a customer's purchased parts). To create a new catalogue, click **New** in the **Catalogue Browser**. This will open a new catalogue on the left.



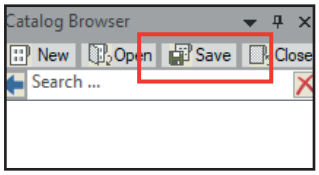
To populate the new catalogue, right-click on the component you want (found in the default FixtureBuilder catalogues), then copy and paste into the newly created catalogue.



Alternatively, it is also possible to drag and drop any component or part from the **Scene Browser** to the **Catalogue Browser**.

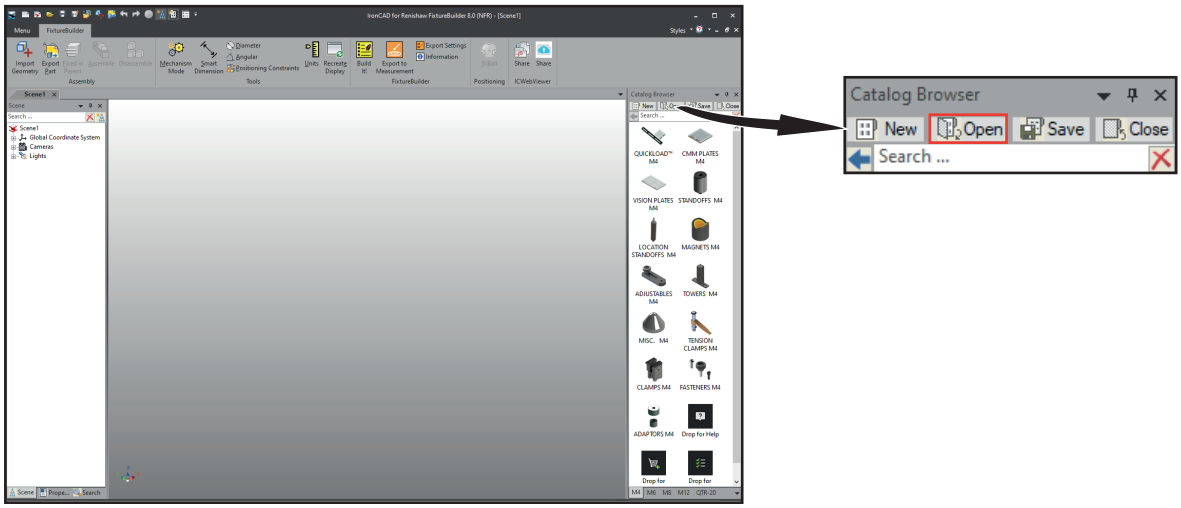


To save the new catalogue, click **Save** on the catalogue section on the ribbon bar to rename and save the new catalogue.

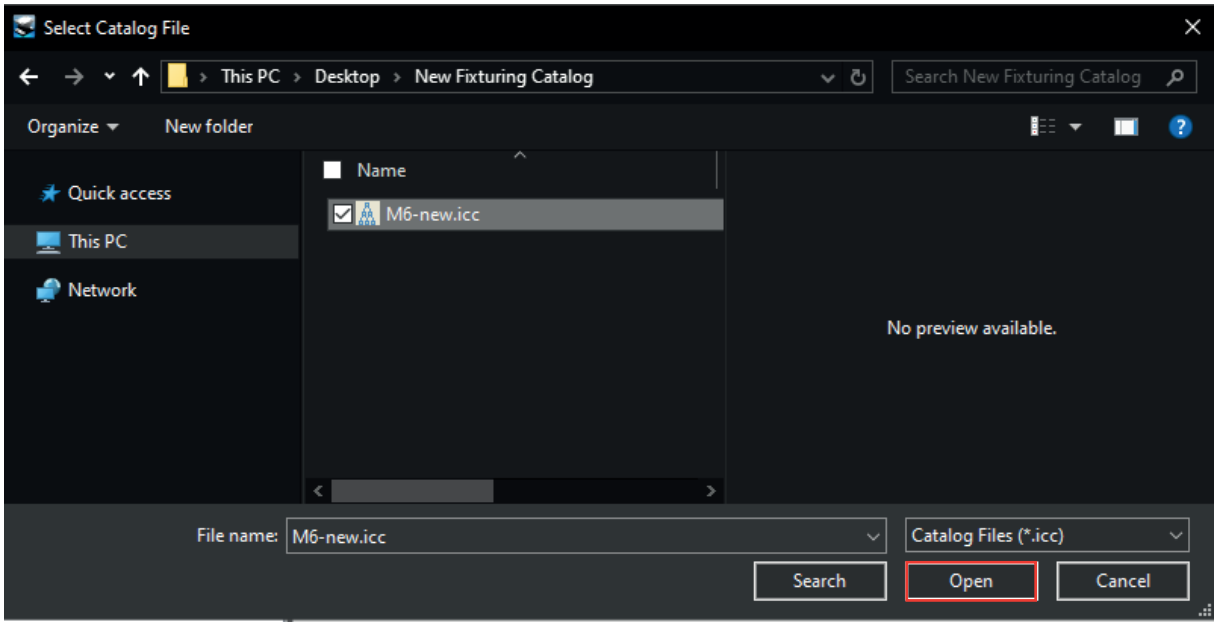


Opening new catalogues

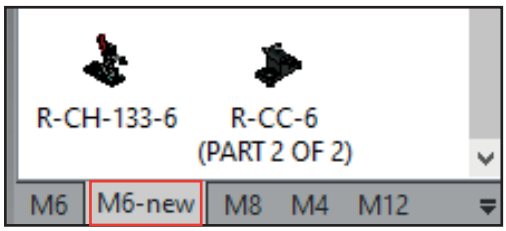
1. On the **Catalogue Browser**, click the **Open** button.



2. Locate the catalogue file you want to open, select it and click **Open**.



3. It will then appear in your **Catalogue Browser** in FixtureBuilder.



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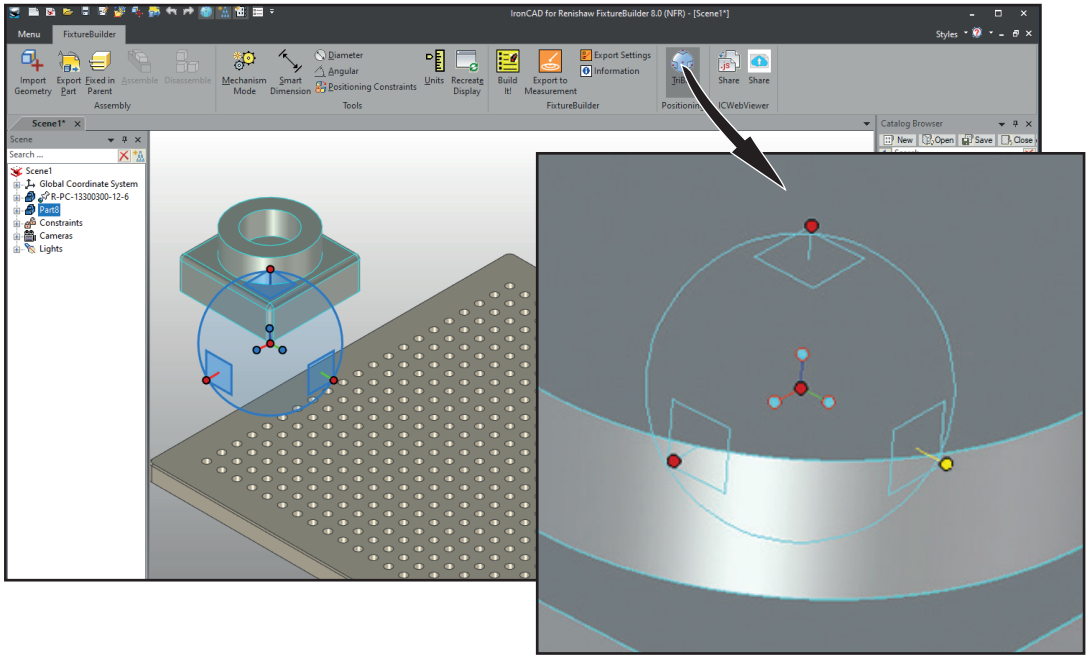
6. Using the TriBall®

The TriBall® is a feature of FixtureBuilder that allows for the quick manipulation of parts within the working environment. Parts can be moved and rotated about the X, Y and Z axes with the left mouse button.

Most FixtureBuilder setups will require some limited TriBall use. As a result, we strongly recommend following this guide to learn all about the TriBall as it will increase your efficiency in fixture setup.

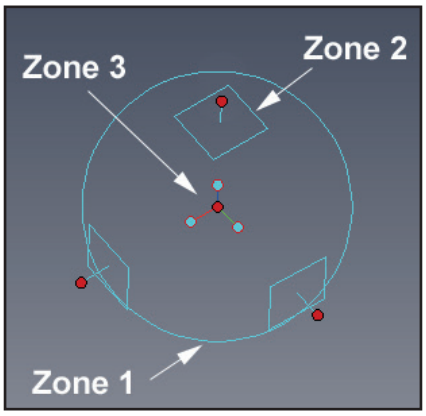
Taking a little time to understand the three functional zones of the TriBall will emphasise the concepts and power of the TriBall.

To activate the TriBall, first select a part – or multiple parts – to move and then click **TriBall** on the ribbon bar (or press the F10 key).

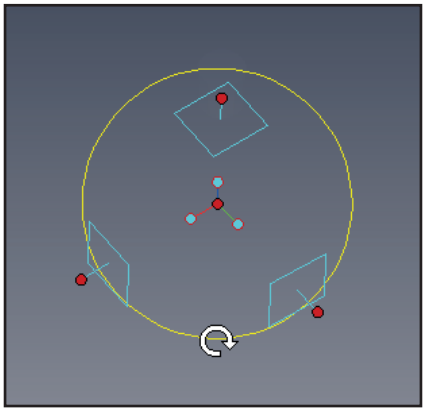


Anatomy of the TriBall

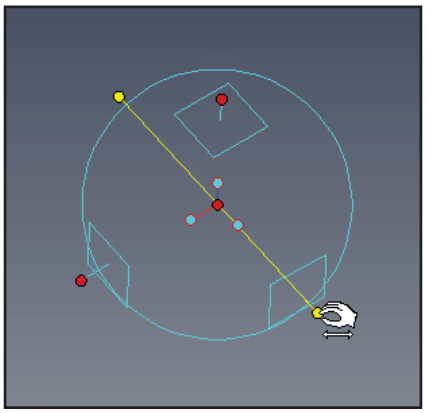
The TriBall provides tools to freely move an object about the plane of the screen (Zone 1), along defined axes, or in planes (Zone 2) using the familiar left-click for visual positioning or right-click for controlled precise movements. In addition, the TriBall provides control of position and orientation of the item being manipulated (Zone 3). The Zone 3 tools are also used to alter and control the position of the TriBall.



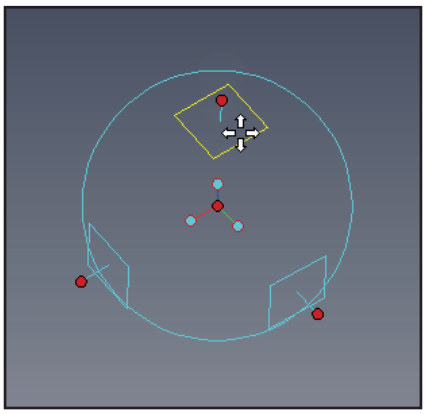
In addition, FixtureBuilder provides visual feedback via the symbol by the cursor:



Rotate/copy in the plane of the screen



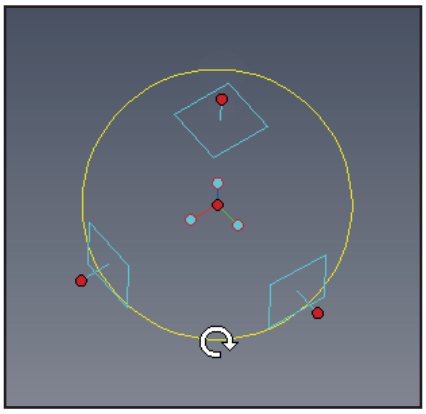
Rotate/copy about a defined axis



Move/copy in plane

TriBall Zone 1

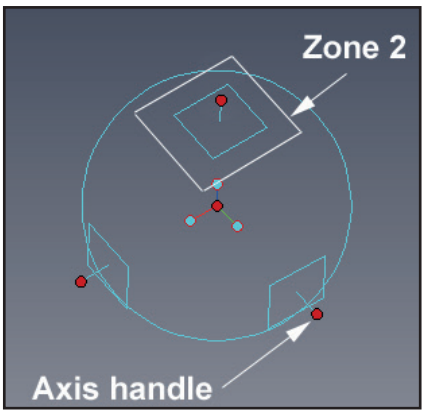
Zone 1 is the circle drawn on screen used to define the outer boundary of the TriBall. By placing the cursor over the boundary circle, the mouse cursor changes to a clockwise rotating arrow and the boundary circle changes from cyan to yellow.



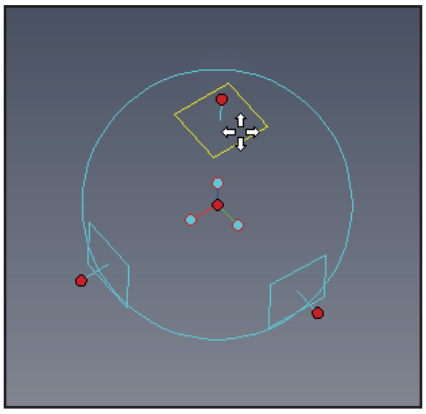
Clicking and dragging the left mouse button while over the boundary circle will rotate the item about the current TriBall centre position in the plane of the screen.

TriBall Zone 2

Zone 2 controls movement along defined axes or planes. Zone 2 controls are probably the most used functions of the TriBall.



On the outside of the boundary circle are three squares that represent individual planes and, as such, are at 90° to each other. Emanating from the centre of each plane is a handle (the axis handle). The planes and axis handles are orientated with respect to the anchor of the item being manipulated. Positioning the cursor over one of the plane symbols results in the cursor graphic changing to four arrows which are perpendicular to each other.

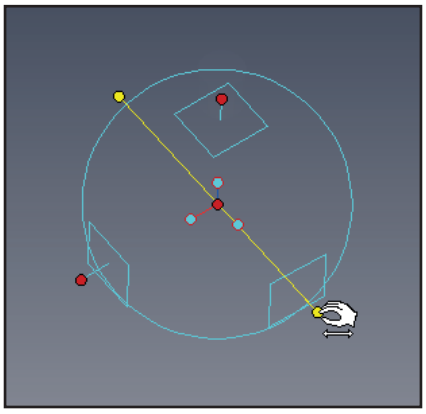


Left-clicking and dragging with the plane highlighted in yellow will visually move the item in that plane. Right-clicking will result in a dialogue giving precise control. As an aid, FixtureBuilder will display a pair of dimensions to give feedback of the movement.

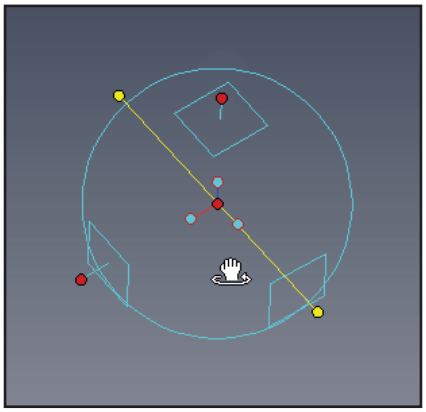
The axes handles are used for three primary actions:

- Moving in a defined direction.
- Rotating about an axis.
- Adding extra control of the direction of movement when positioning using the Zone 3 functions.

Clicking on one of the handles will highlight the handle passing through the TriBall. This declares an axis for movement or control even when simply clicking on the handle and dragging in one movement.

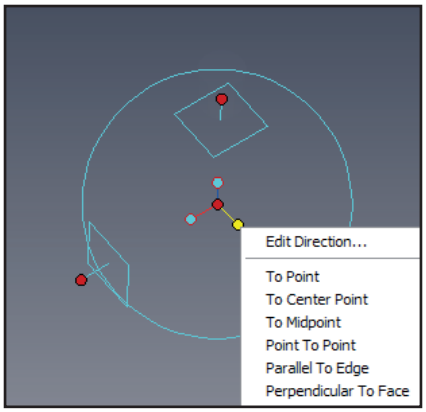


Again, FixtureBuilder will give feedback of any positional changes and change the cursor shape. With the axis 'declared', moving the mouse pointer inside of the outer boundary circle will cause FixtureBuilder to change the cursor shape one more time. By clicking and moving the cursor (keeping it inside the boundary circle) the item will be rotated about the declared axis.



TriBall Zone 3

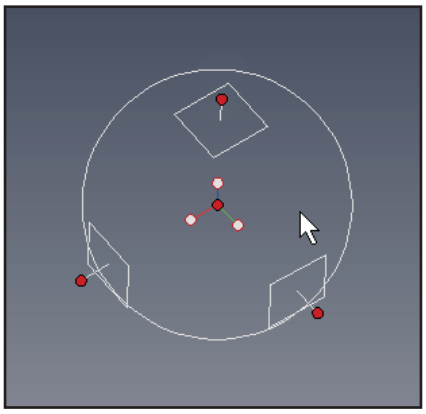
Zone 3 refers to the inner three orientation handles with cyan ends and the centre red point. The controls provided by Zone 3 impact the orientation of the item being manipulated (such as parallel to an edge for example) or the TriBall. To view the full range of options, right-click on one of the cyan handles.



The centre red point (the centre handle) provides a quick way to freely drag the item to an existing point on any model in the scene. Simply click on the centre handle and, with the mouse button pressed, drag to the desired point on any model in the scene. To assist, FixtureBuilder will provide SmartSnap feedback to position the item. Furthermore, if an axis handle is selected, FixtureBuilder will align the item being manipulated along the axis but aligned to the selected point.

Repositioning the TriBall

The TriBall would not be quite so powerful if its position was fixed within an item or space. Pressing the space bar when the TriBall is active results in the TriBall base colour changing from cyan to white and any resulting manipulations impacting the TriBall itself and not the item.



Tutorial

As you have learned, fixtures are easily created using the drag and drop functionality. Sometimes users will require positioning / movement / orientation without snapping to a smart attachment point. We recommend following this tutorial to learn all about the TriBall and how it can help you to become a FixtureBuilder Power User!

Practical example using the TriBall

The following example will introduce the fundamentals of Zones 2 and 3 in a practical way. At the time of installation, FixtureBuilder installs a scene file under the **Tutorials** folder. By default (for version 8.0), this is:

Program Files\FixtureBuilder\2019\Tutorials\en-us

The scene file is **triball1.ics**. The example will show the power provided by the TriBall by:

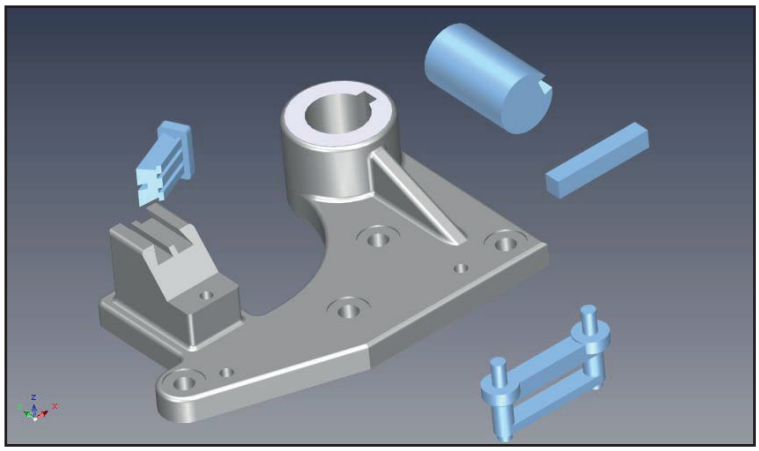
- Using the centre handle of the TriBall.
- Using the inner “orientation handles” of the TriBall.
- Using the space bar to detach and reposition the TriBall.
- Temporarily constraining (declaring) an axis of the TriBall.
- Increment snapping with the TriBall.
- Using the TriBall to copy radial / linear array patterns.
- **To Point** command.
- **Point to Point** command.
- **Parallel to Edge** command.
- **Perpendicular to Face** command.

- **To Centre Point** command.
- **Parallel to Axis** command.
- **Reverse** command.
- Creating 'Patterns'.

FixtureBuilder has three keyboard commands for the TriBall:

F10	Turn the TriBall on / off.
SPACE	Detach / attach the TriBall with selected object.
CTRL	Activate incremental snapping for translation / rotation.

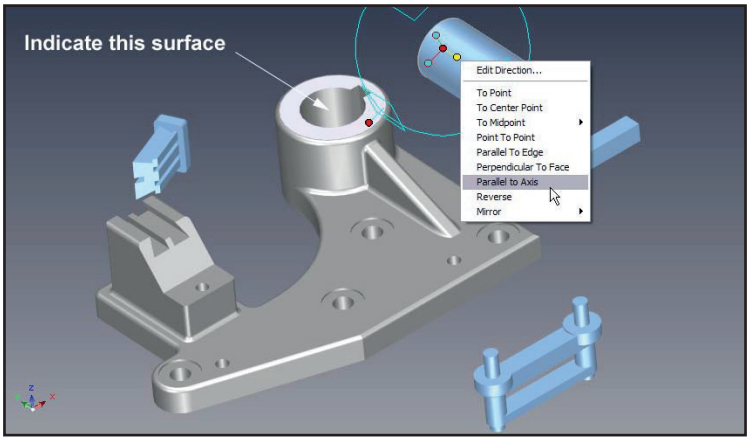
Open the file **triball1.ics**. It should look similar to the following image (however, the background of the image below has been changed to help show the scene contents better).



Using the TriBall's Orientation Handles to position parts

Select the shaft shown and turn on the TriBall.

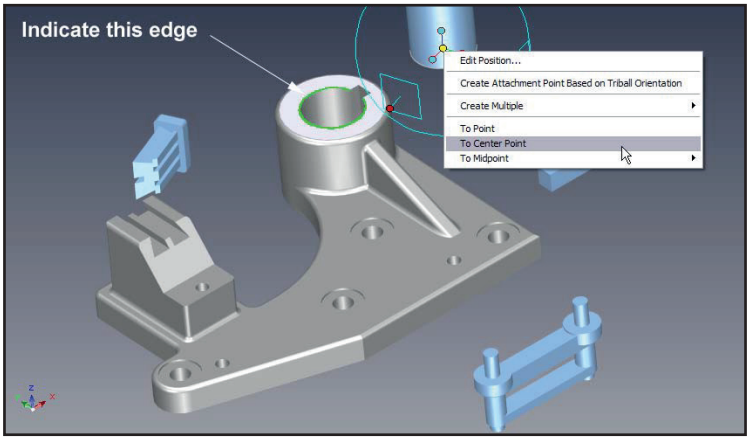
Right-click on the orientation handle (Zone 3) running parallel to the axis of the shaft (as shown) and choose **Parallel to Axis** from the resulting pop-up menu.



Next, click on the cylindrical surface of the main grey part shown in the image. This will cause the shaft's selected axis to be aligned with the axis of the hole. Note that, in this case, the outer surface of the hole could have been chosen instead of the inner surface and the result would have been identical.

Using the TriBall's centre point to position parts

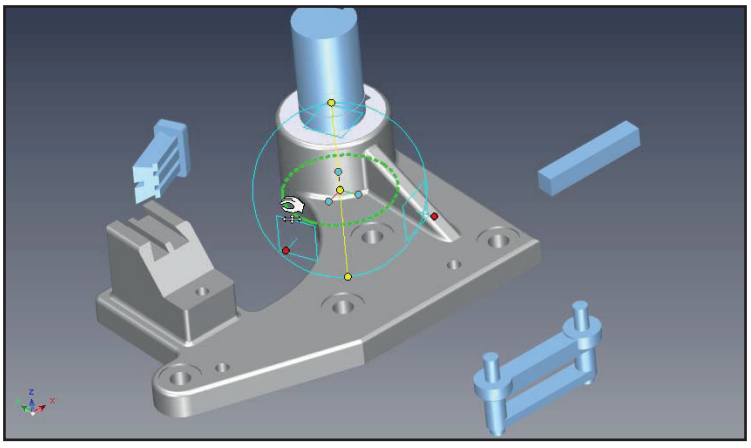
To move the shaft over to the hole's centre, right-click the centre of the TriBall and choose **To Centre-point** from the resulting pop-up menu.



Next, click on the circular edge shown. This will move the TriBall centre (and the shaft) to the centre point of the target selection.

Temporarily constraining (declaring) an axis of the TriBall

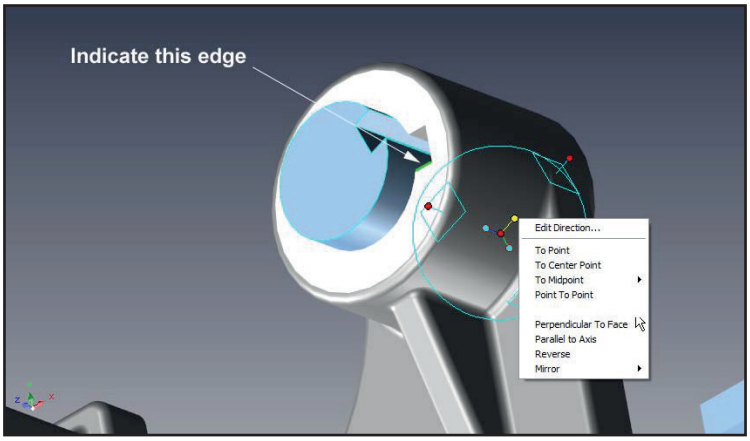
Slide the shaft down to the base of the hole by first clicking on the top outer (Zone 2) TriBall handle shown. This action will cause the vertical axis of the TriBall to become highlighted in yellow, which means the TriBall is now temporarily constrained to move/rotate only along/about that axis.



Next, drag the centre of the TriBall by left-clicking and holding the mouse button pressed on the TriBall centre red dot to the lower circular edge as shown. By declaring the axis, the cursor is effectively free to move outside of the TriBall to enable other features or parts to be selected. The shaft should 'slide' down the constrained vertical axis and snap perfectly into alignment with the bottom of the hole.

Parallel to Edge command

Manipulate the viewing position to get a clearer view of the keyway in the shaft and housing. To align the keyway, right-click on the centre orientation handle (Zone 3) shown and choose **Parallel to Edge** from the resulting pop-up menu.

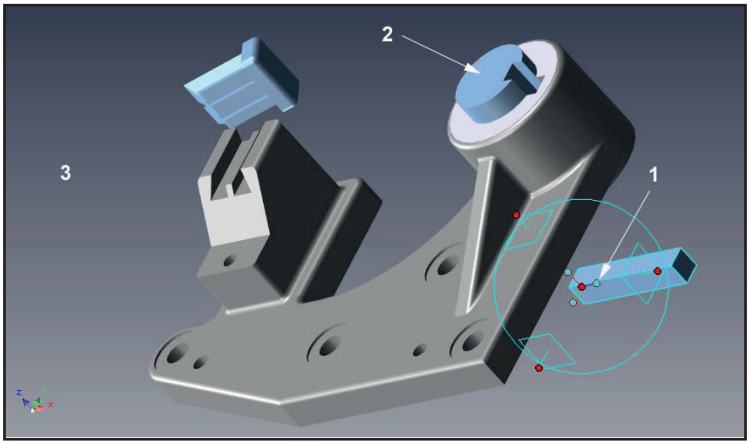


Next, click on the edge shown on the keyway. This will cause the selected axis of the TriBall to become aligned with the target edge by rotating about the TriBall centre point.

Turn off the TriBall either by pressing F10 or by clicking on its icon.

Perpendicular to Face command

To insert the key into the keyway, select the key and turn on the TriBall.

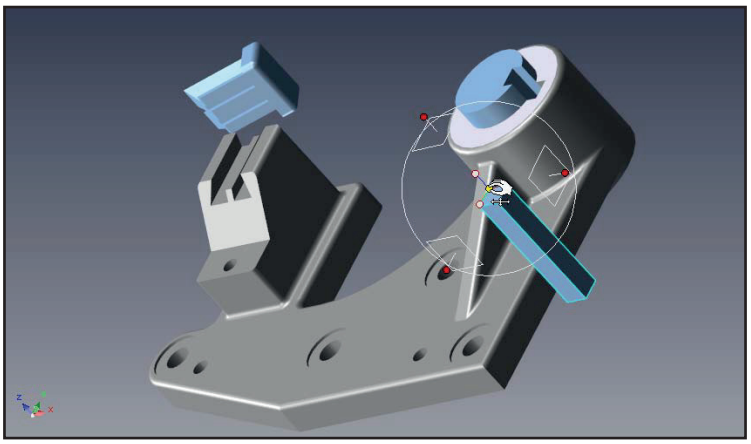


Align the key with the keyway by right-clicking on the centre orientation handle shown (1) and choose **Perpendicular to Face** from the resulting pop-up menu.

Next, click the top surface of the shaft positioned previously (2). This will cause the selected axis of the TriBall to become aligned perpendicular with the target face. Click in a blank area (3) of the scene to deselect the selected axis.

Drag-and-Drop method of repositioning the TriBall

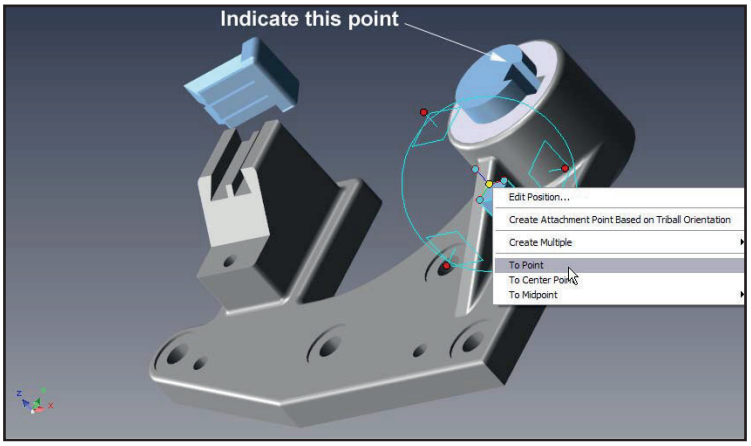
Relocate the TriBall on the part by pressing the space bar. The TriBall colour will now change to white, indicating that it is 'detached' and can be moved independently of the part. Drag the centre of the TriBall to the corner of the key as shown (zoom in, if necessary).



Press the space bar again to re-attach the TriBall to the part (colour returns to blue).

To Point command

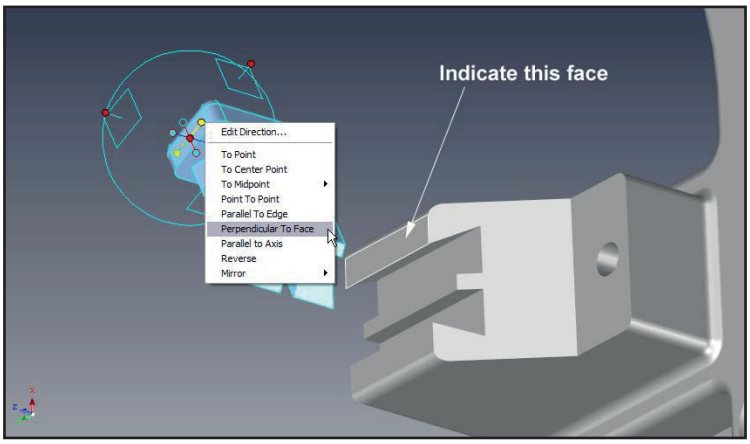
Position the key into the keyway by right-clicking the centre of the TriBall and choose **To Point** from the resulting pop-up menu. Next, select the corner point of the shaft or alternately drag the centre of the TriBall to the corner point of the shaft. Both approaches will provide the same result.



The key should now be assembled into the keyway. Turn off the TriBall either by pressing F10 or by clicking on its icon.

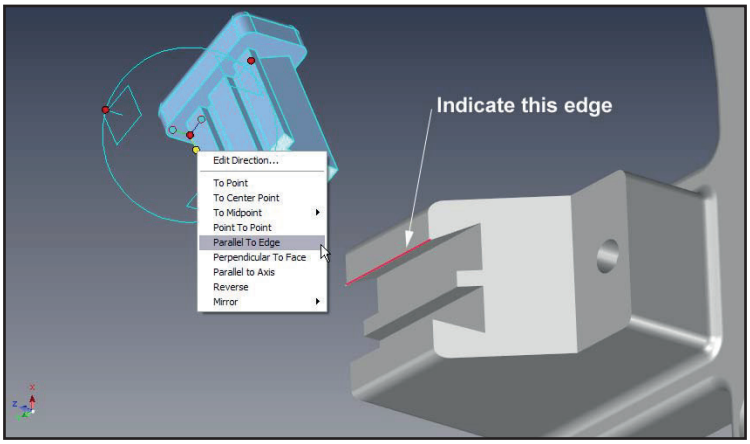
Aligning the Dovetail component

Select the dovetail part and turn on the TriBall. Referring to the image below, right click on the orientation handle shown and choose **Perpendicular to Face** from the resulting pop-up menu.



Click the face shown in the image and then deselect the handle by left-clicking in the scene background.

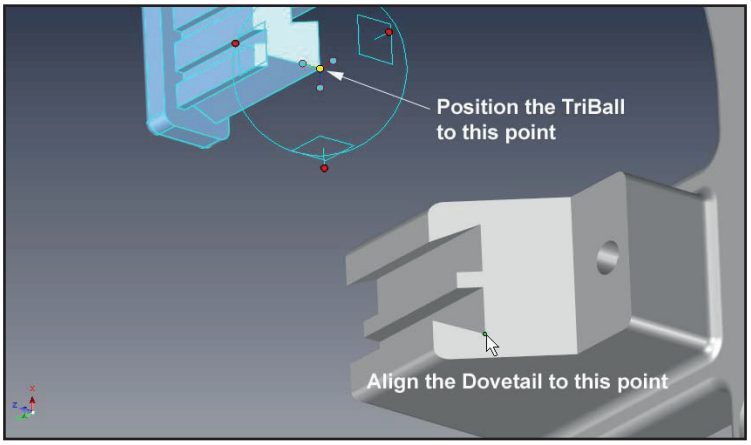
To align the dovetail component to the dovetail grooves, right-click on the orientation handle parallel to the grooves and choose **Parallel to Edge** from the resulting pop-up menu and then indicate the edge shown in the image below.



Click in a blank area of the scene to deselect the selected axis.

Relocate the TriBall on the part by pressing the space bar. The TriBall colour will now change to white, indicating that it is “detached” and can be moved independently of the part.

Now, drag the centre of the TriBall to the corner shown. Then press the space bar again to re-attach the TriBall to the part (colour returns to blue). Once the TriBall has been locked in place, left click on the centre point of the TriBall and drag the dovetail component into position by indicating the point shown in the following image. FixtureBuilder will help in this process by using the SmartSnap feedback.

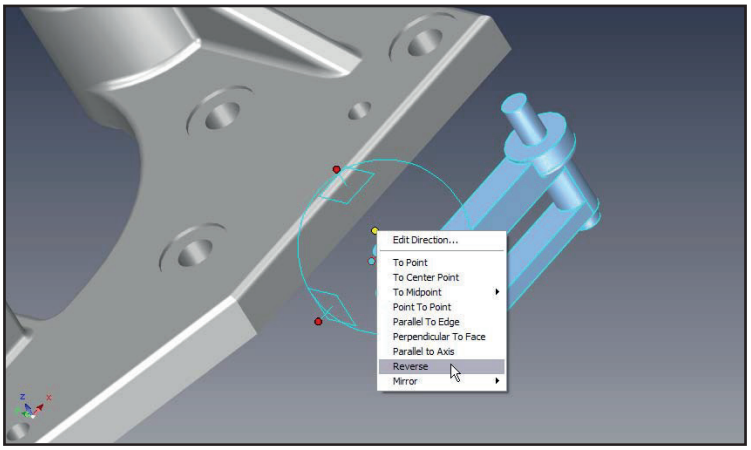


Alternately, right-click the centre of the TriBall and choose **To Point** from the resulting pop-up menu and then select the same point.

The part should now be assembled correctly.

The TriBall Reverse command

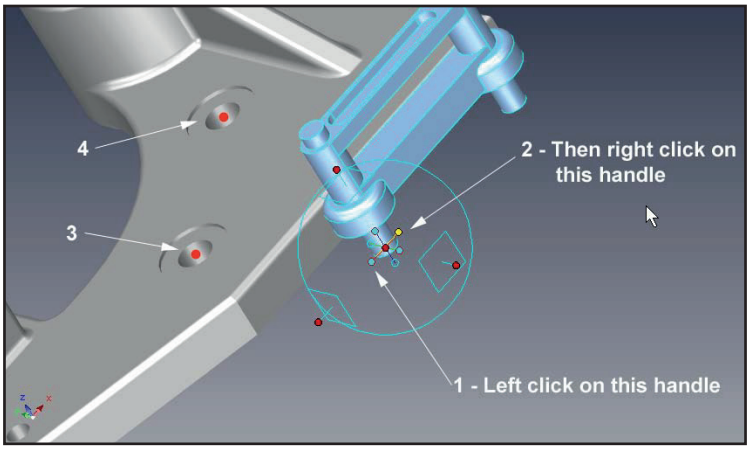
If the TriBall is still active on the dovetail component, turn it off and select the part shown and turn the TriBall back on.



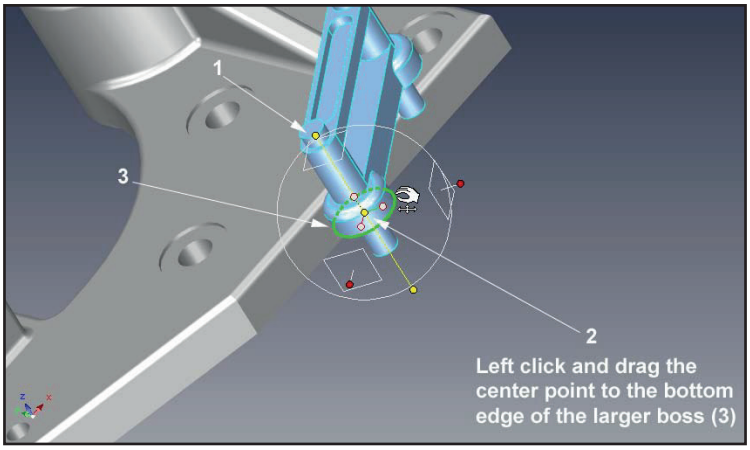
Right-click on the top orientation handle shown and choose **Reverse** from the resulting pop-up menu. This will 'flip' the part 180° in the direction of the selected axis (note: reverse is different to mirroring the part).

Point to Point command

The TriBall is displayed with the minimum of handles to help maintain a clean working environment. However, when a handle is selected, FixtureBuilder displays the opposite handle. For example, to align the pegs with the holes, select the orientation handle in the next image (1) by left-clicking. FixtureBuilder will display the opposite handle (2) first. Right-clicking on the newly displayed orientation handle will indicate to FixtureBuilder the direction of manipulation. From the pop-up menu, select **Point to Point** and select the target hole centre points (3) followed by (4). This will cause the selected axis of the TriBall to become aligned parallel to a virtual line between the two target points. Undo the command and this time indicate the hole centre points in the opposite sense.



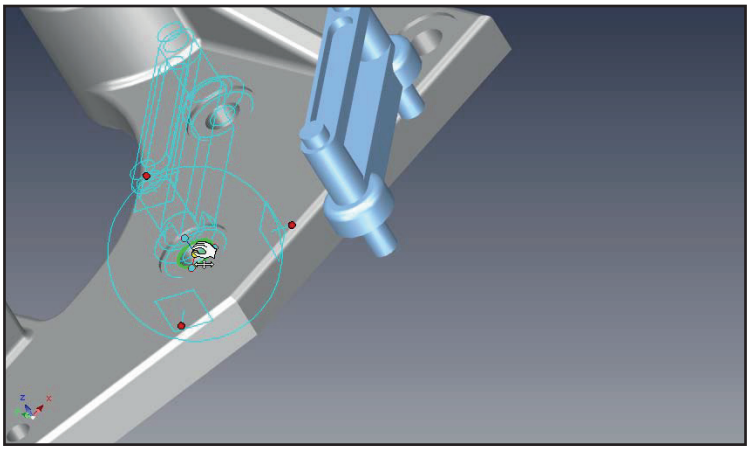
Relocate the TriBall on a feature of the part reflecting how it would be assembled by pressing the space bar. FixtureBuilder will change the TriBall colour to white. Next, referring to the following image, click on the top outer TriBall handle (1). This action will cause the vertical axis of the TriBall to become highlighted in yellow, which indicates that the TriBall is now temporarily constrained to move/rotate only on that axis.



With the axis constrained and the TriBall highlighted in white, drag the centre of the TriBall (2) to the lower circular edge (3). The TriBall should ‘slide’ up the constrained vertical axis and snap perfectly into alignment with the base of the peg. Lock the TriBall to the new position by pressing the space bar and the TriBall will turn back to cyan.

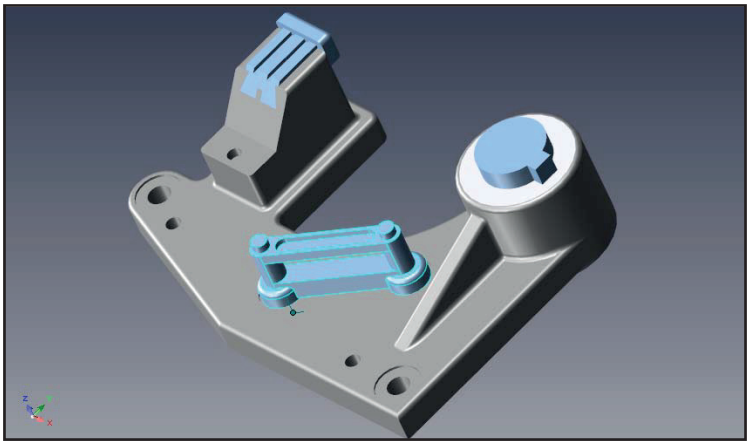
Click in a blank area of the scene to deselect the selected axis.

To place the pegs in the holes, simply drag the centre of the TriBall to the centre of the hole.



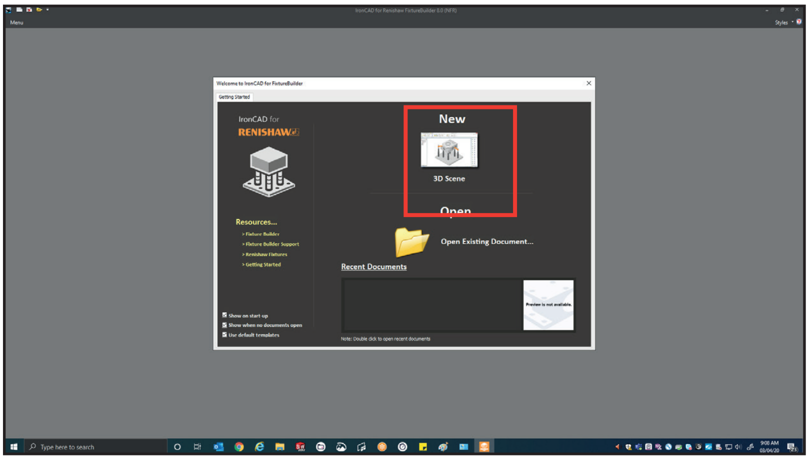
An alternative method to achieve the same result is to right-click on the centre of the TriBall and select **To Centre Point** from the resulting pop-up menu and then click the circular edge of the hole.

The assembly is now complete and should look like the following image.



7. Creating a fixture

If you do not have a scene already open, create a new scene by clicking either on **New** in the welcome window or on **New Scene** in the top of the ribbon bar.



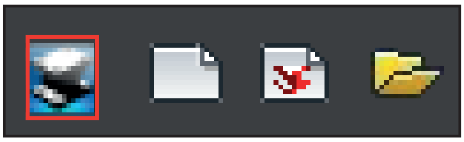
Useful keys

F7 – Positions the viewpoint to a face/feature by clicking on the item you want to look at.

F8 – Fits the fixture to the scene.

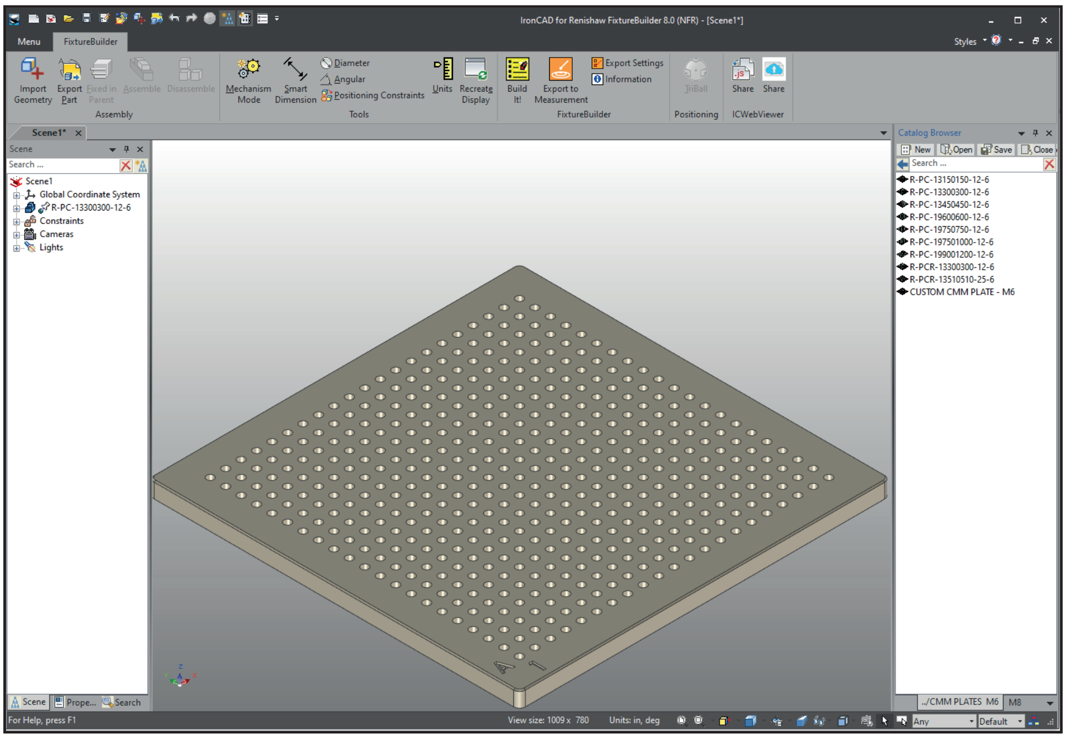
F9 – Turns on/off perspective mode.

F10 – Activates/de-activates the TriBall.

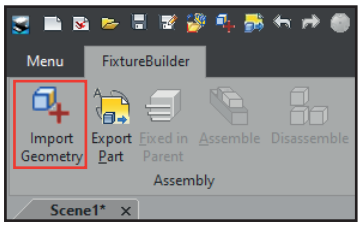


The first step with creating any fixture usually starts with a base plate (this should be selected based on the part size or machine you are using). To position a plate in the scene, select an appropriate plate from the Plates catalogue. To position the plate, simply drag it out of the catalogue and drop it into the scene.

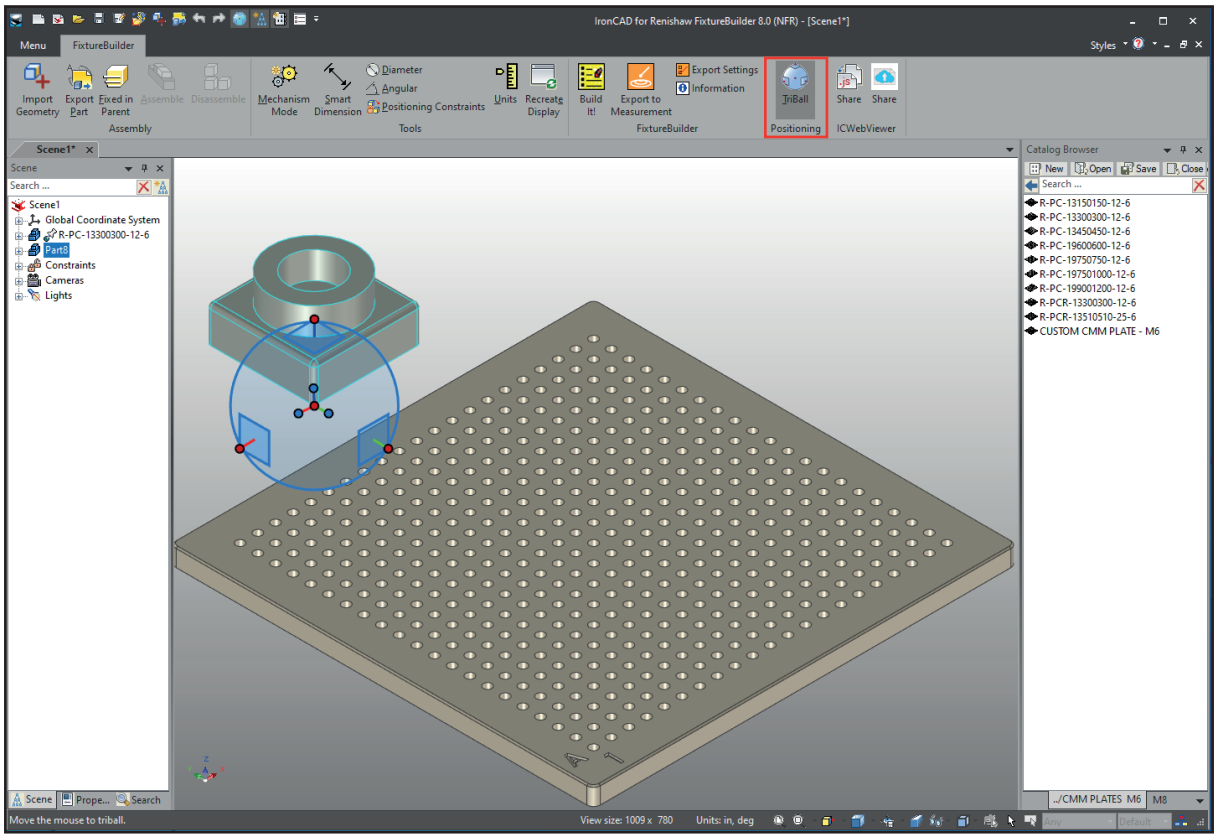
Note: After dropping the plate, pressing F8 will fit the plate to the scene window.



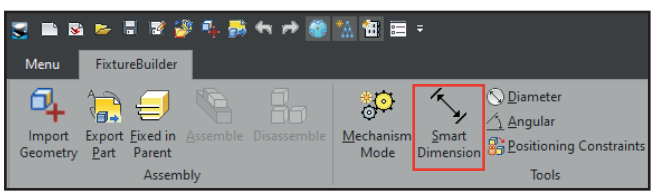
After the plate has been placed, you can now import a part. Click **Import Geometry** on the ribbon bar, select a suitable file and click **Open**. (FixtureBuilder supports all major CAD formats: visit the Renishaw FixtureBuilder web page at **www.renishaw.com/fixturebuilder** for full details.)



The part will need to be approximately positioned within the scene. Typically, parts will be centralised on the plate; however, this can change when multiple parts are added to one plate. To position the part, select it and press **TriBall** or F10. The part can then be moved as shown in section 6, “Using the TriBall®”. More accurate positioning will follow once the fixture has been built.

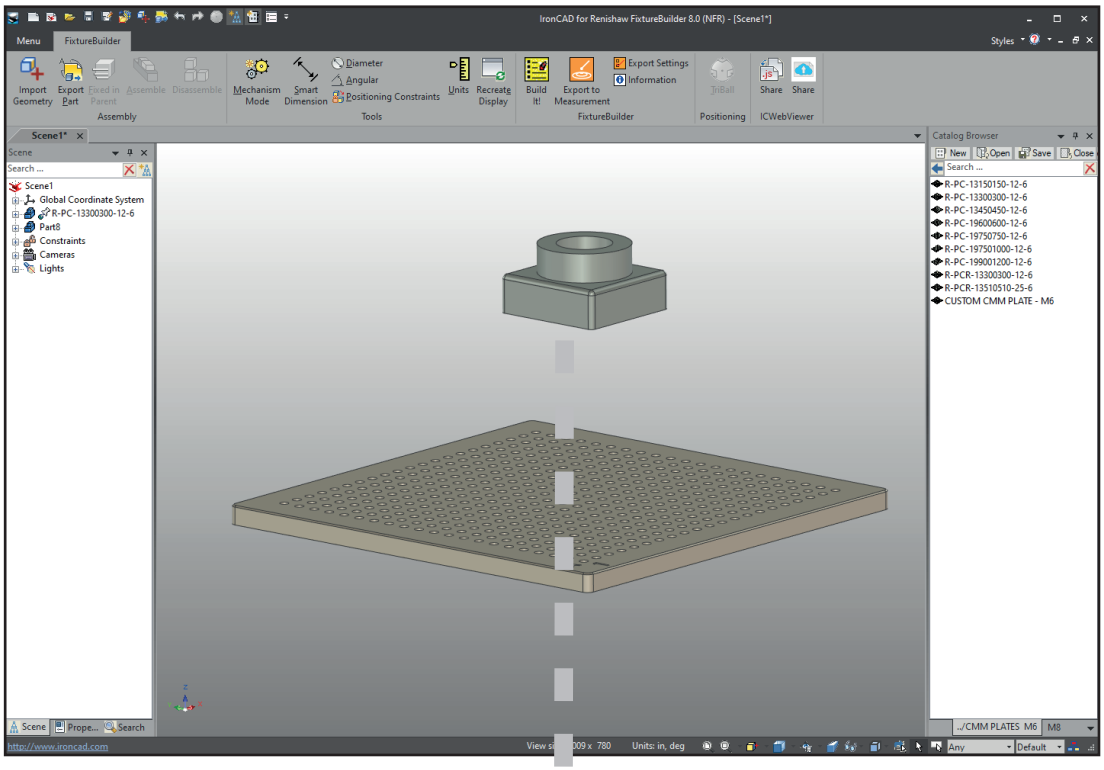


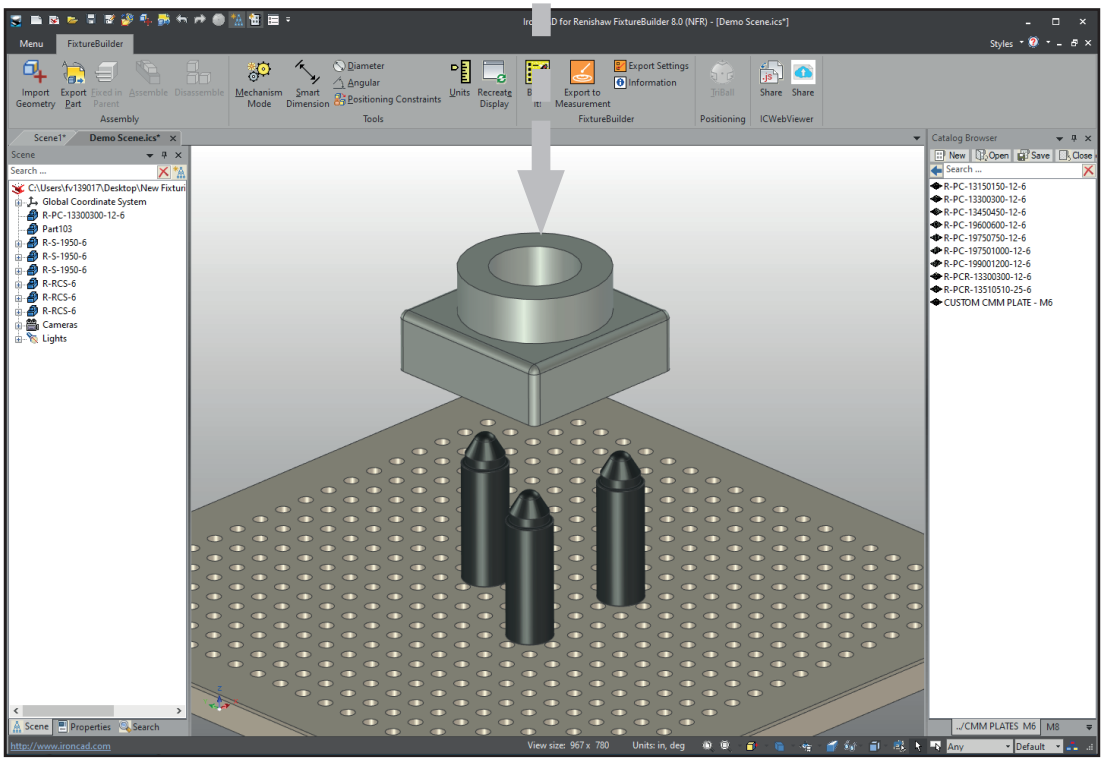
Note: You can check how high the part is positioned above the plate by using the **Smart Dimension** tool on the ribbon bar. This may be useful for machines with restricted measuring ranges.



Once the part is positioned on the plate, the fixturing components can then be added. To do this, simply drag and drop the components from their relevant catalogues. As you drag the component over the plate, the software will inform you of the hole position you are about to drop the component into. To stack components, drag the next component over the top of the previous one and it will automatically snap into position.

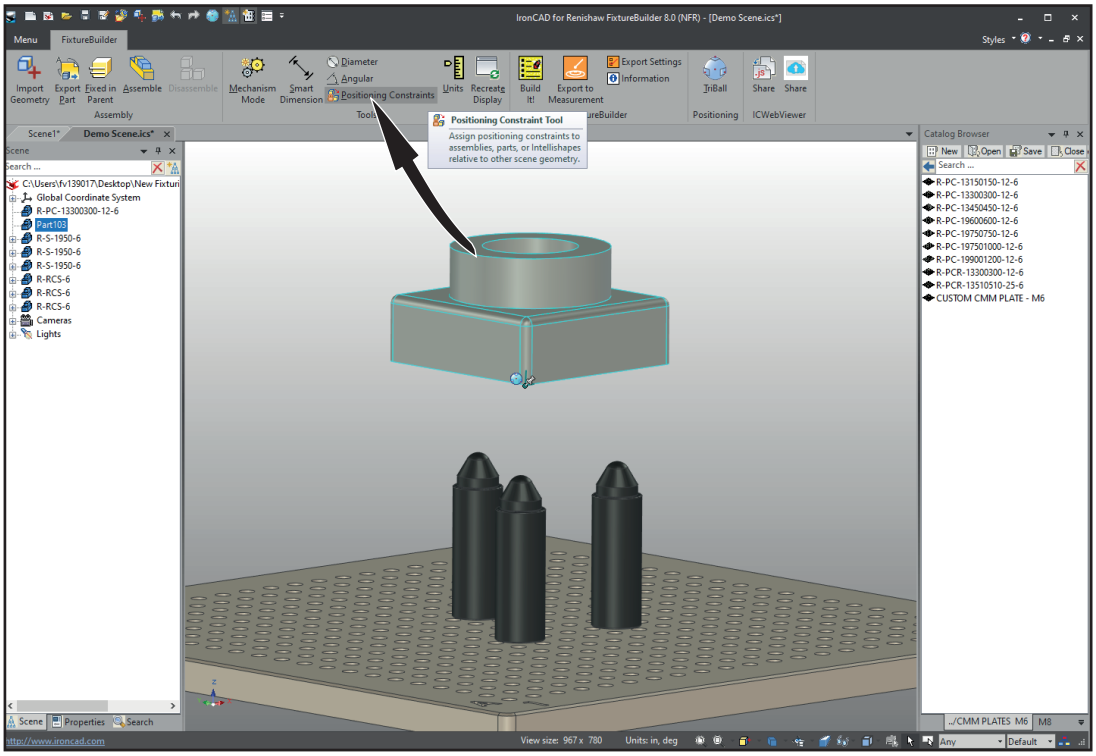
Note: Always remember to build fixtures using the “3-2-1” principle to ensure the fixture is both stable and repeatable. See section 2, “Fixturing principles”.



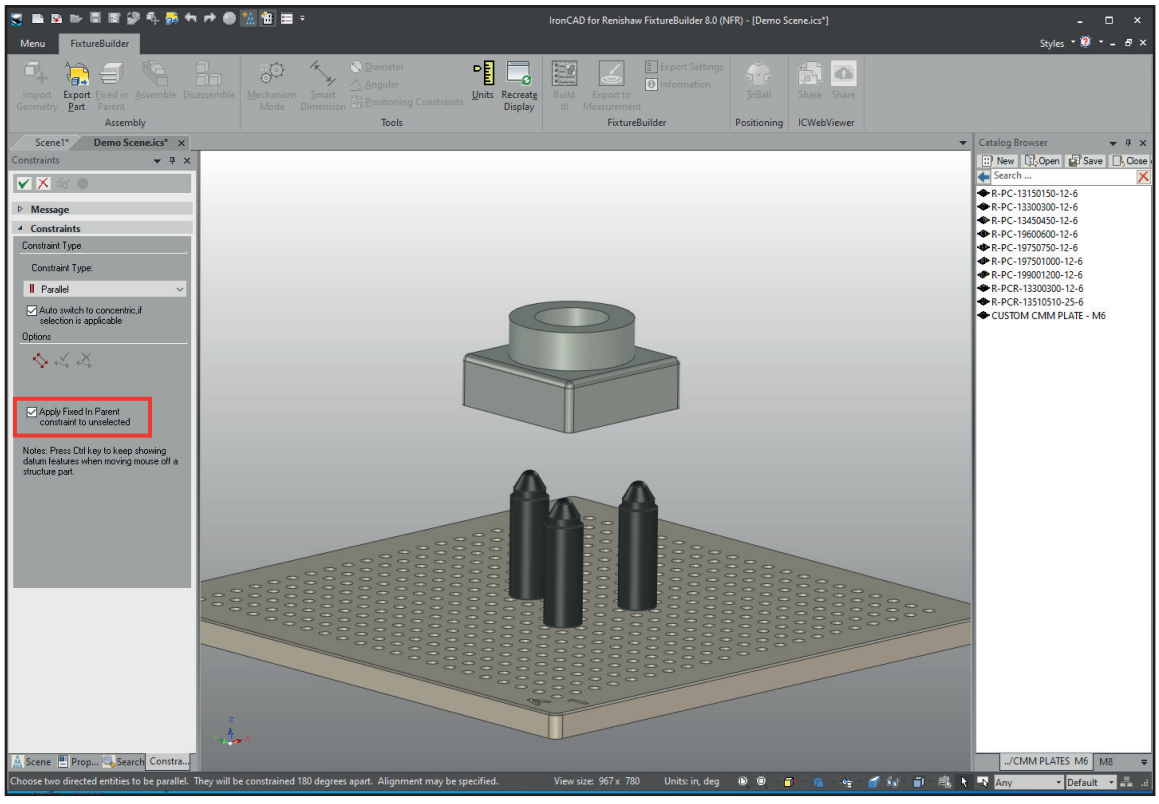


Use the **Positioning Constraints** tool to position the part on the fixture. This allows you to assign relationships between the part and the fixture to ensure the part is correctly positioned.

To do this, **first select the part you wish to constrain**: it will then be outlined either in blue (if it is a single part), or yellow (if it is an assembly). When it is selected, click **Positioning Constraints** on the ribbon bar. This will show the **Positioning Constraints** tool on the left-hand side.

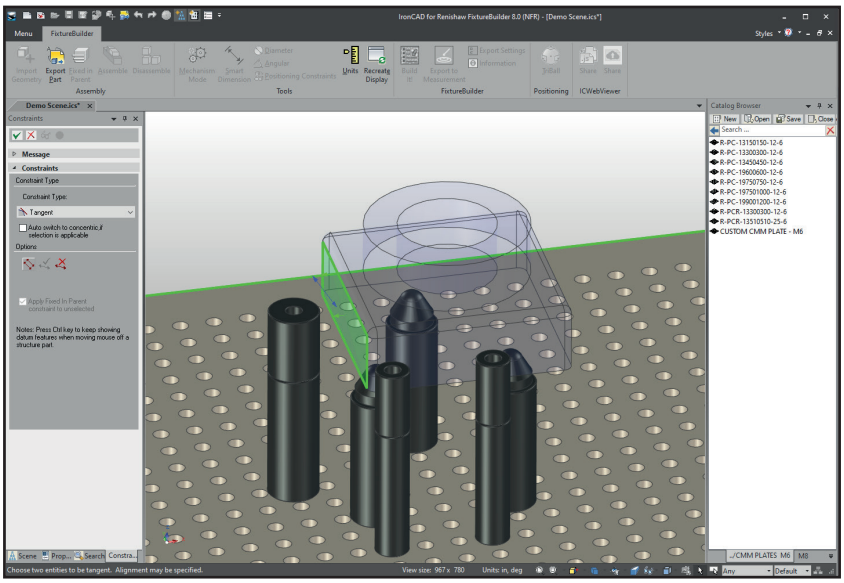


Important: Before applying any constraints, ensure the highlighted box below is ticked before assigning constraints, as this allows the software to understand which parts to move when constraints are applied.

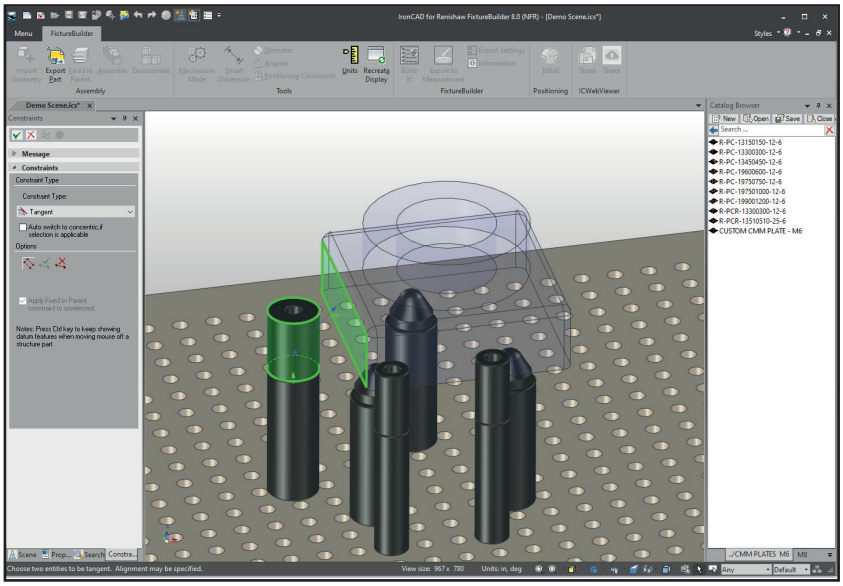


Various constraint options are available for aligning the part to the fixture, the most common will be “mate” and “tangent”. Mate constraints align two faces together, and tangent constraints are used to align a flat surface with a cylinder. In the illustration below, tangent constraints have been used to assign the part to the XZ axes supports of the fixture.

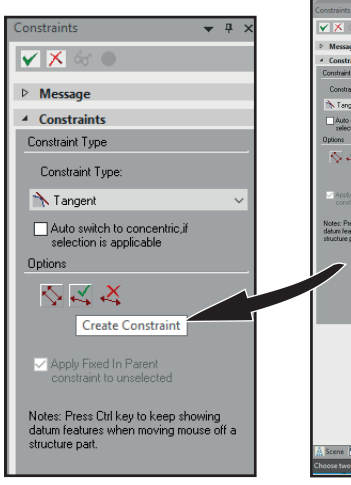
Step 1: First select the part you wish to constrain (see page 28) and then select the face of the part you want to move.

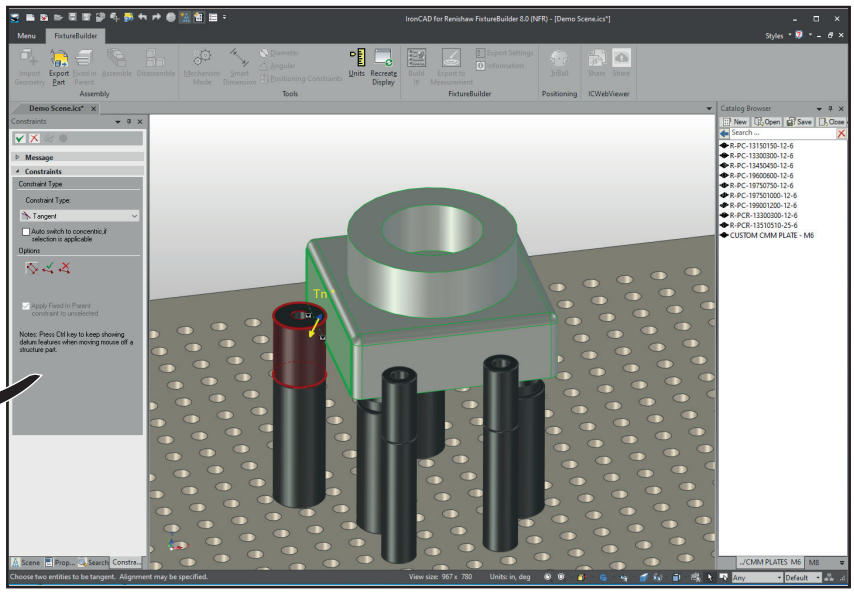


Step 2: Select the face of the fixture component.

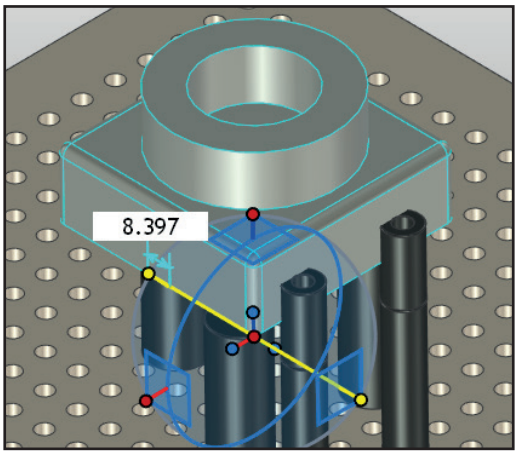


Step 3: Click **Create Constraint** to stay. in the positioning constraints mode

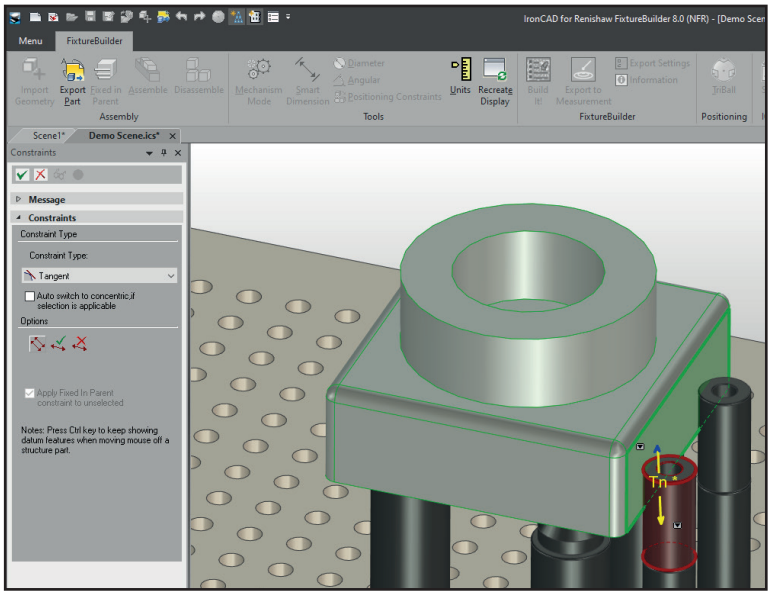


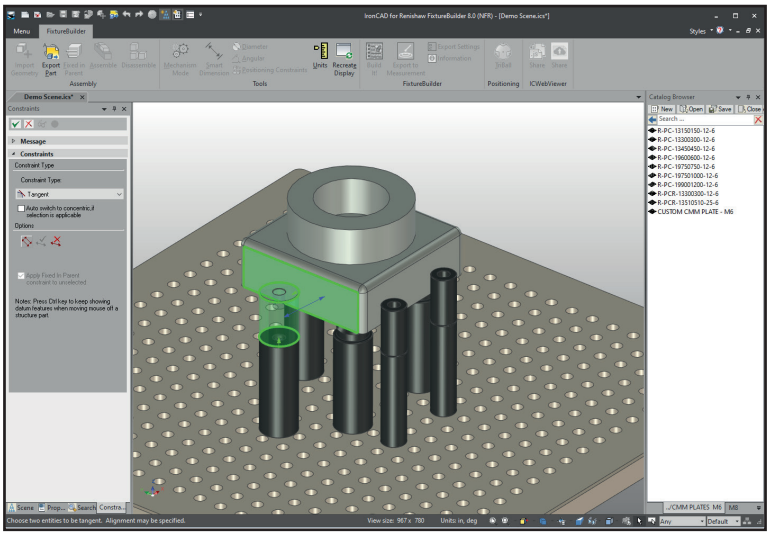


Note: Sometimes, when applying constraints, the part will overlap fixturing components. If this happens, to ensure the constraints solver uses the correct face, it is recommended to reposition the part using the TriBall away from the fixturing components.



Further constraints can then be added to align the part with the X and Y axes fixture positions. Take care to always select the part before clicking **Positioning Constraints** and ensure that the tick box is checked in the constraints box (see page 28).

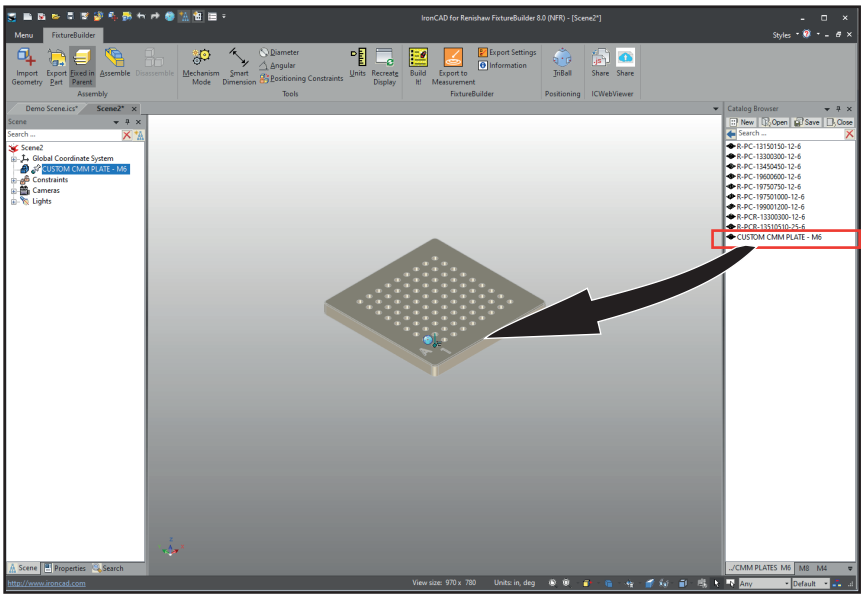




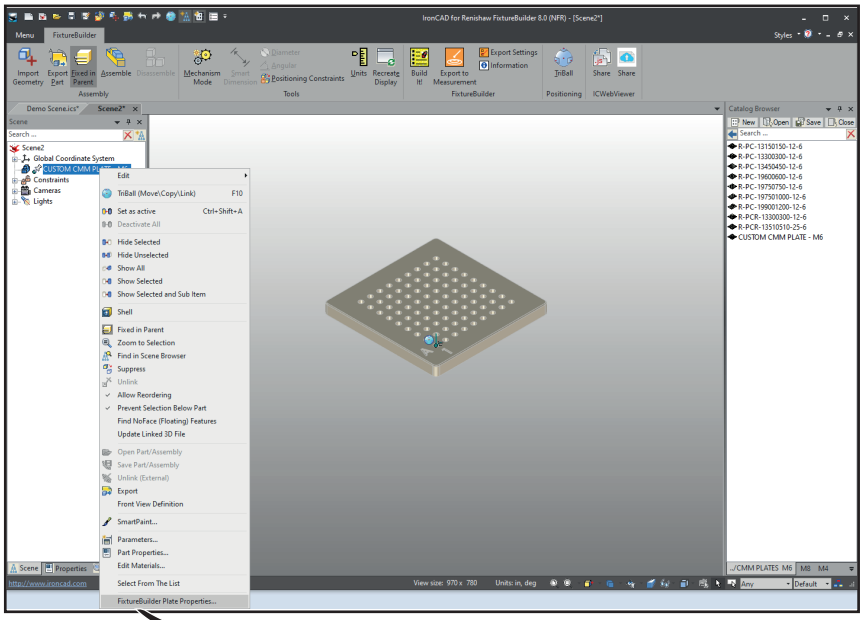
8. How to create a custom plate : FixtureBuilder plate properties

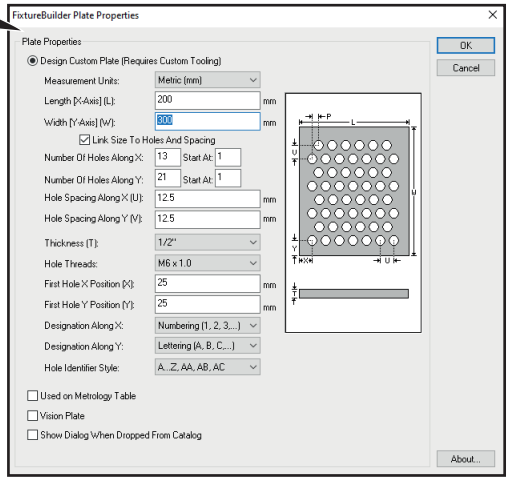
In each plate catalogue there is a **CUSTOM PLATE** component that can be customised.

Step 1: Drag and drop a plate in the scene.



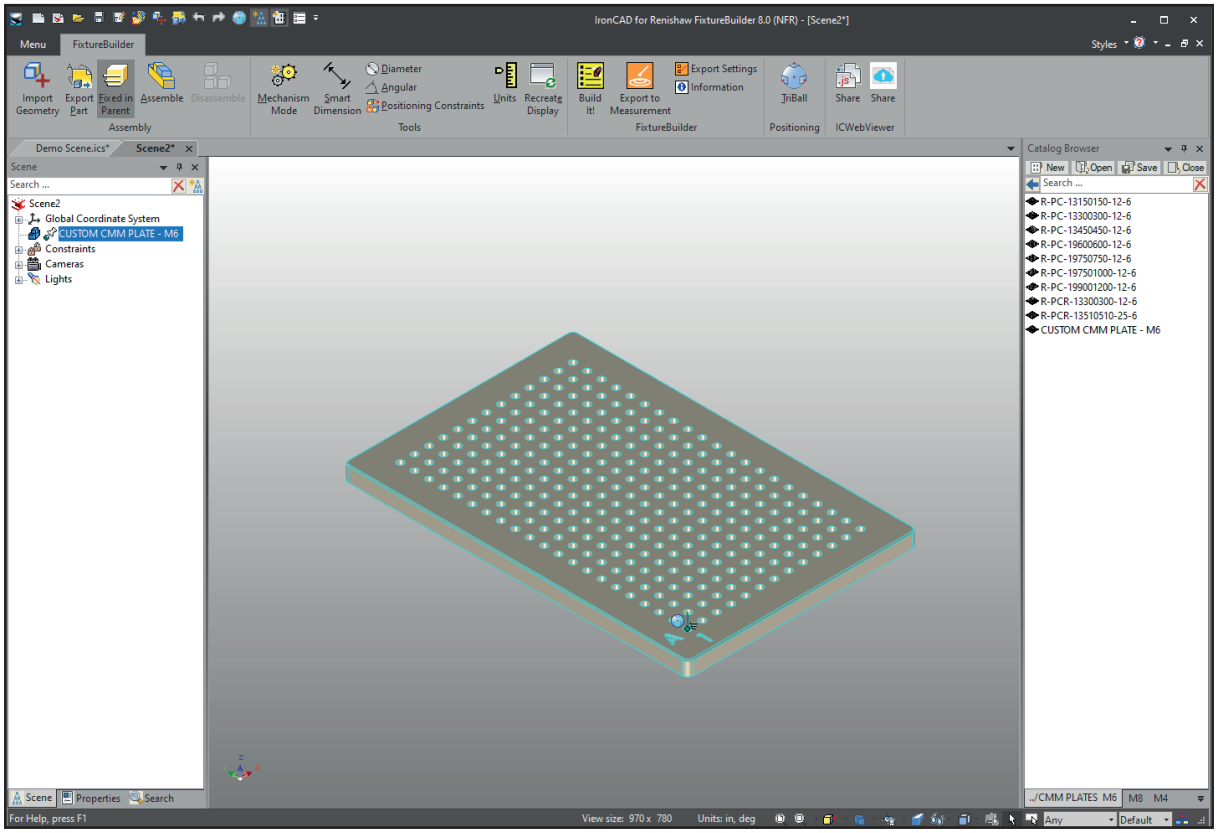
Step 2: Right click on the plate and then click on **FixtureBuilder Plate Properties**.





Step 3: Update the applicable properties and click **OK**.

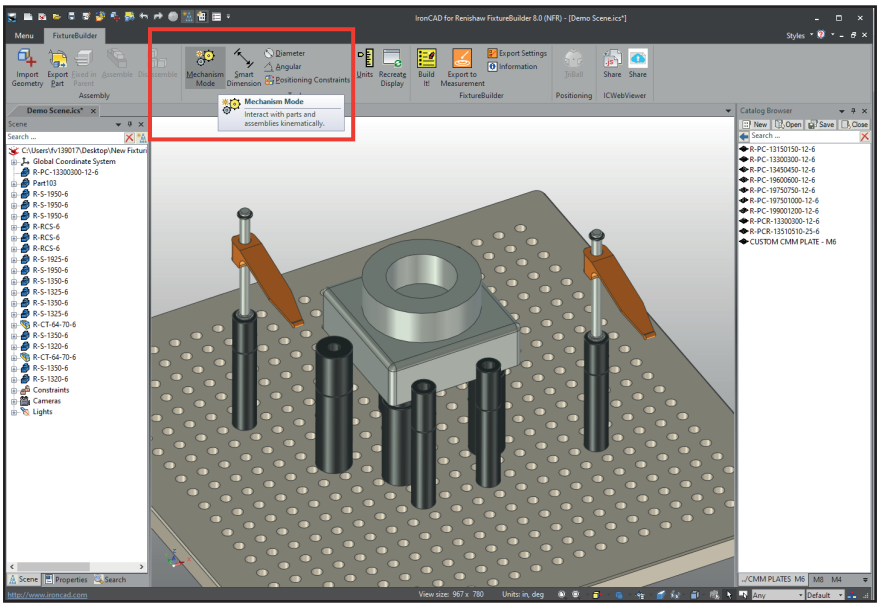
Step 4: Once you click **OK**, the plate will automatically update the properties.



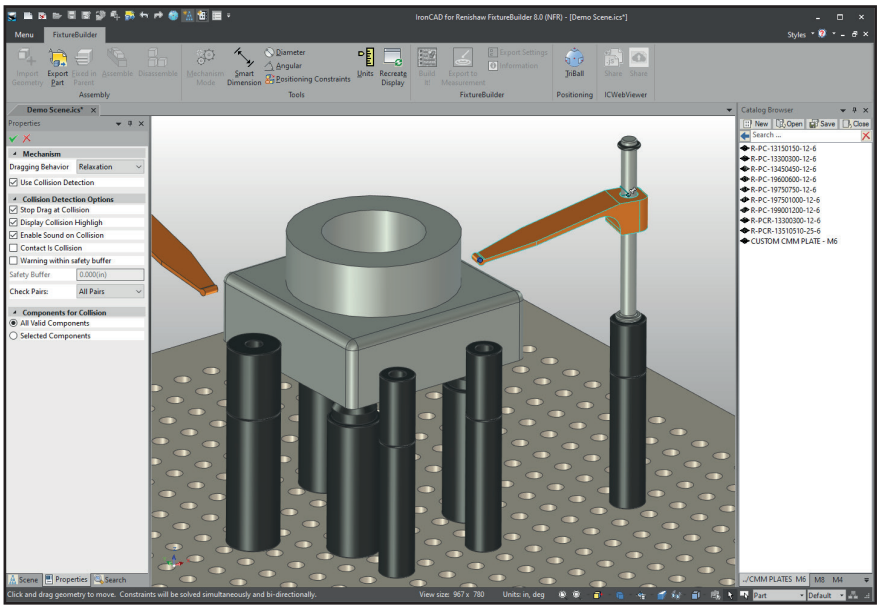
9. Mechanism Mode

Mechanism Mode is a tool within FixtureBuilder that allows the user to manipulate fixturing components to move as they would in real life. This is done by simply clicking and dragging on the adjustable part of the fixturing component. This will only work with components that have a degree of freedom. Collision detection is then used to stop the components moving any further when they come into contact with a part. **Mechanism Mode** will commonly be used for assigning clamps to a part and pushing adjustable slide bases into position.

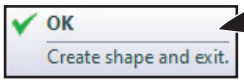
Step 1: Click **Mechanism Mode** on the ribbon bar.

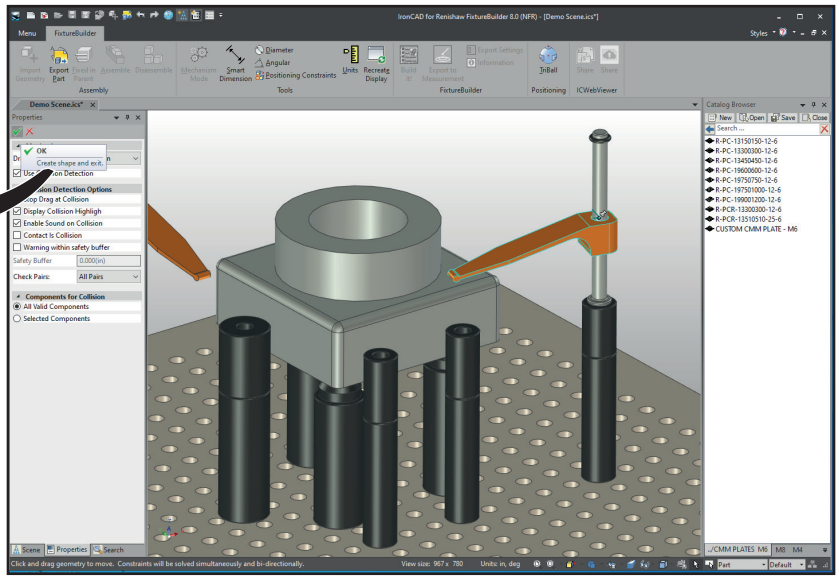


Step 2: Drag the fixture component into place on the part (collision detection will stop the part moving).



Step 3: Click **OK**.





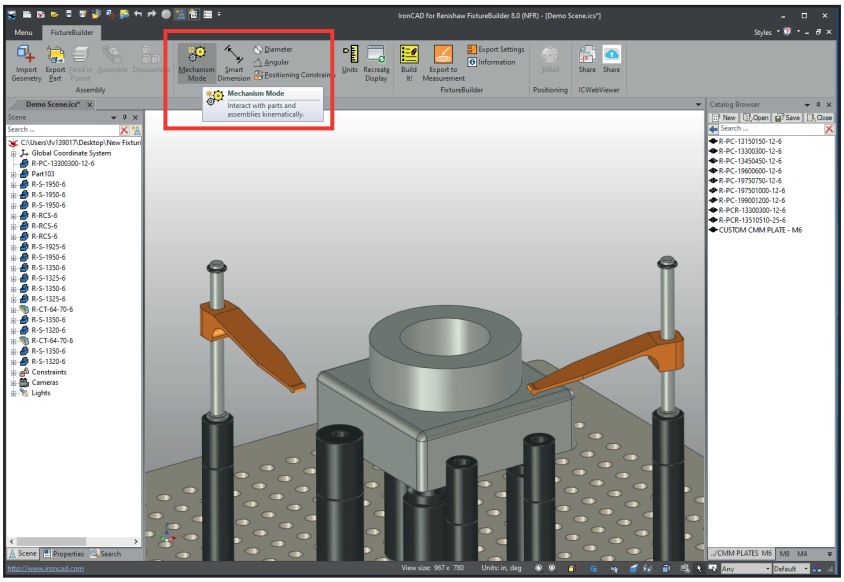
Mechanism Mode can also be used to move adjustable height stands, slide bases, and so on.

Note: Ensure the adjustable section of the fixturing component is dragged (for instance, the tension clamp arm) and that standoffs are repositioned outside of **Mechanism Mode**.

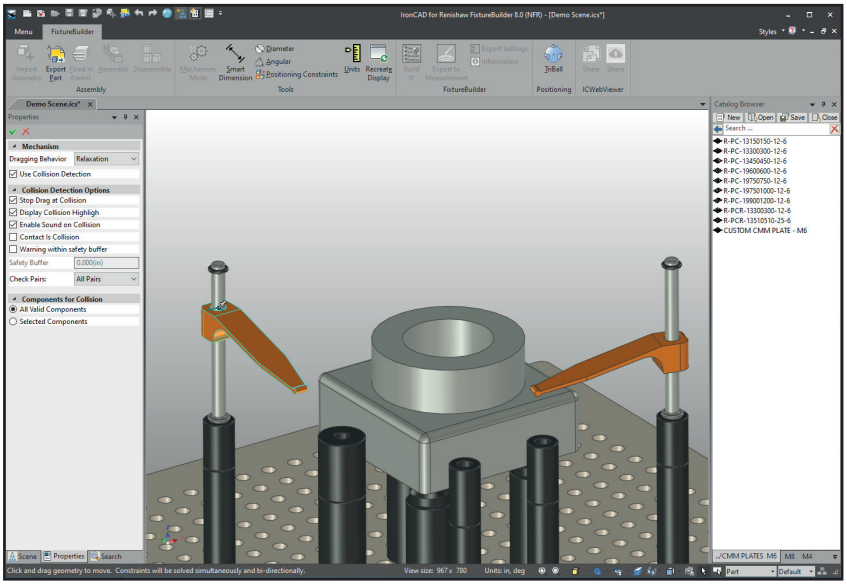
Mechanism Mode with TriBall

Mechanism Mode can also be used with the Triball for more precise movement:

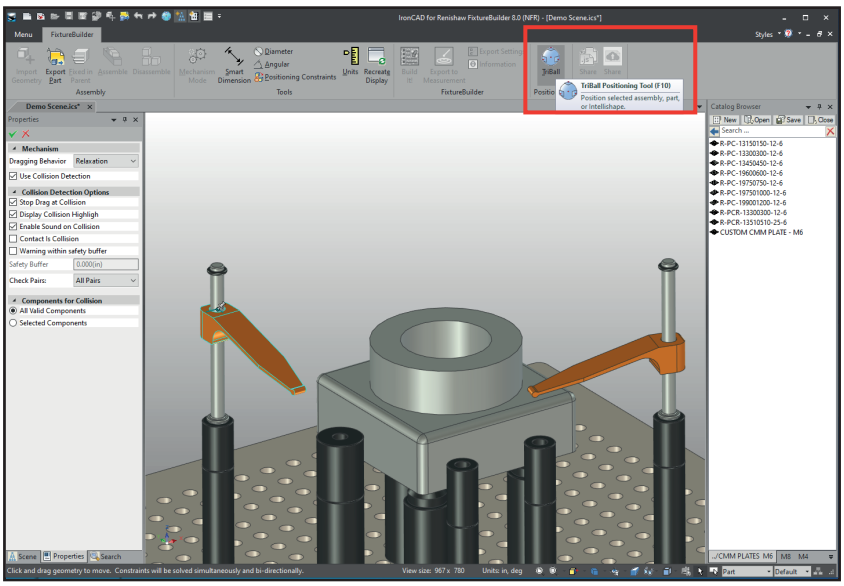
Step 1: Click **Mechanism Mode** on the ribbon bar.



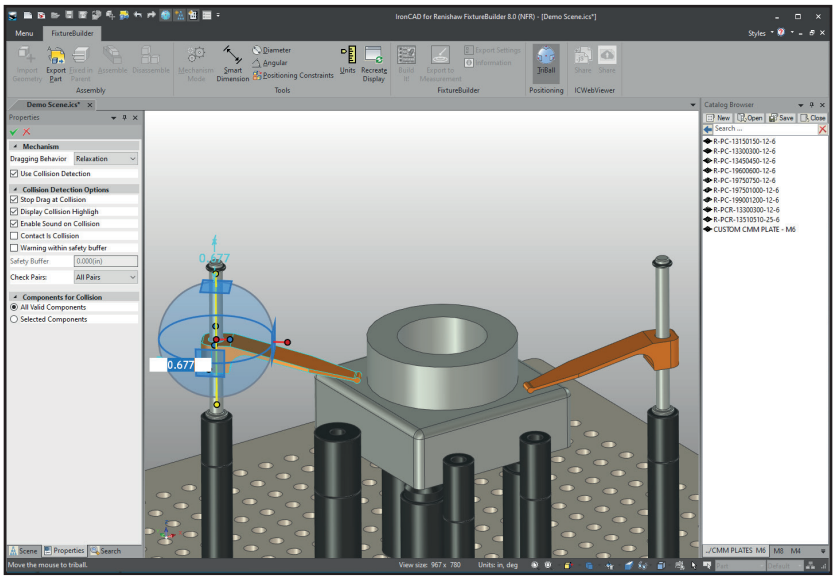
Step 2: Single click on the part you want to move, it will then be outlined in blue.



Step 3: Click **Triball** on the ribbon bar (or press F10):



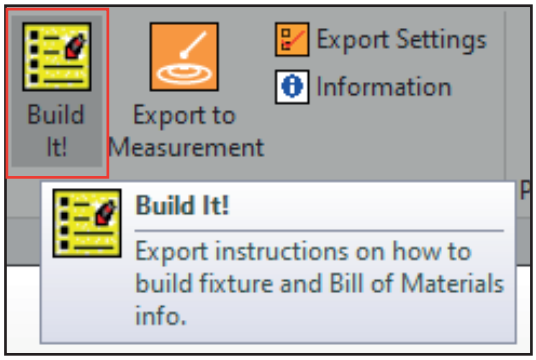
Step 4: Move the part using the Triball as explained in section 6, “Using the TriBall”.



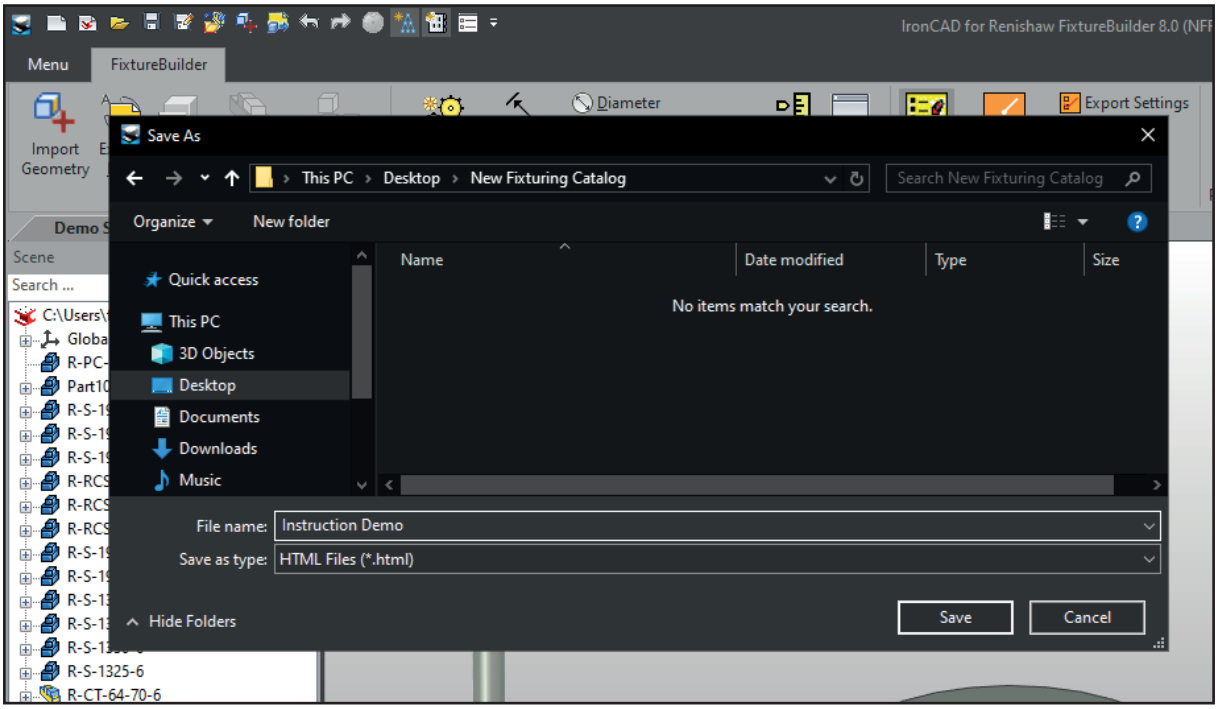
Note: The benefit in using the Triball with Mechanism mode is to be able to have the **Collision Detection** mode on while using accurate movements from the Triball.

10. Creating the Build It document

When the fixture is complete, click **Build It!** in the ribbon bar.

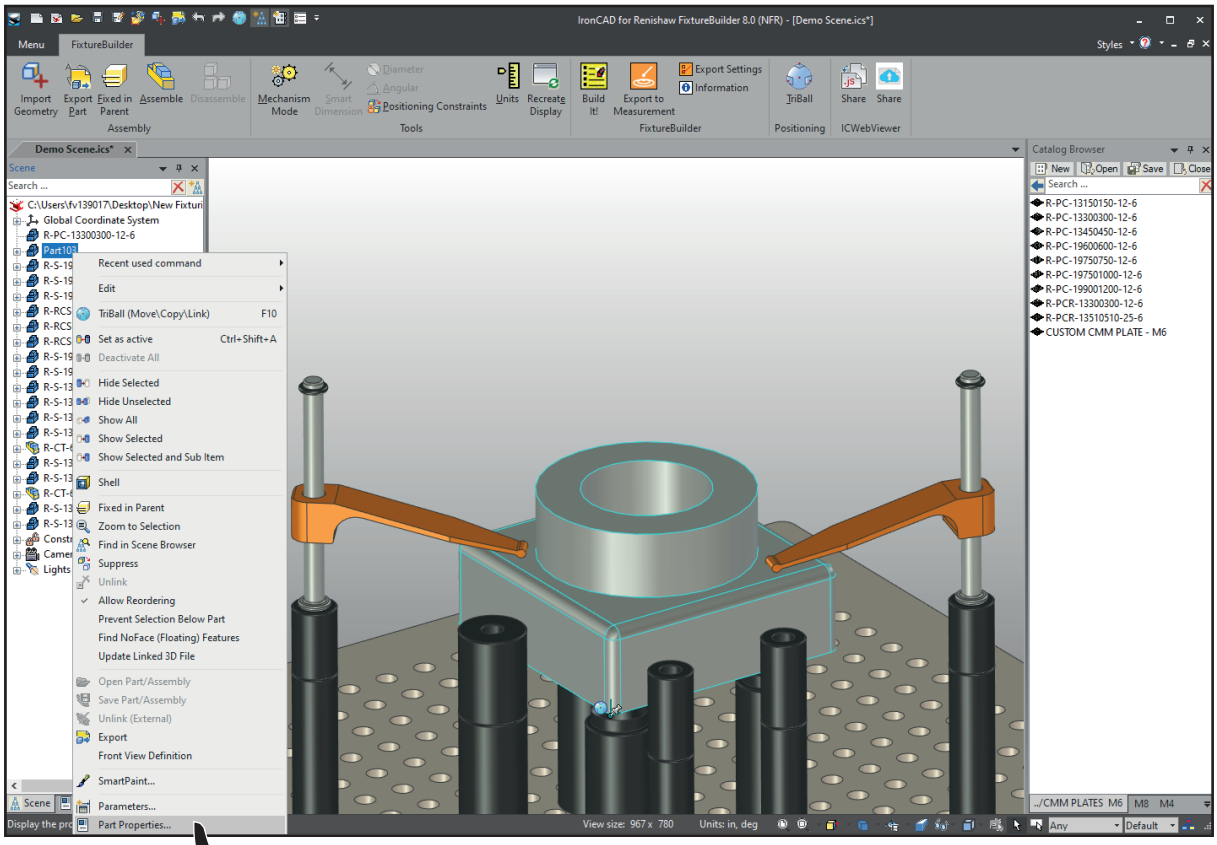


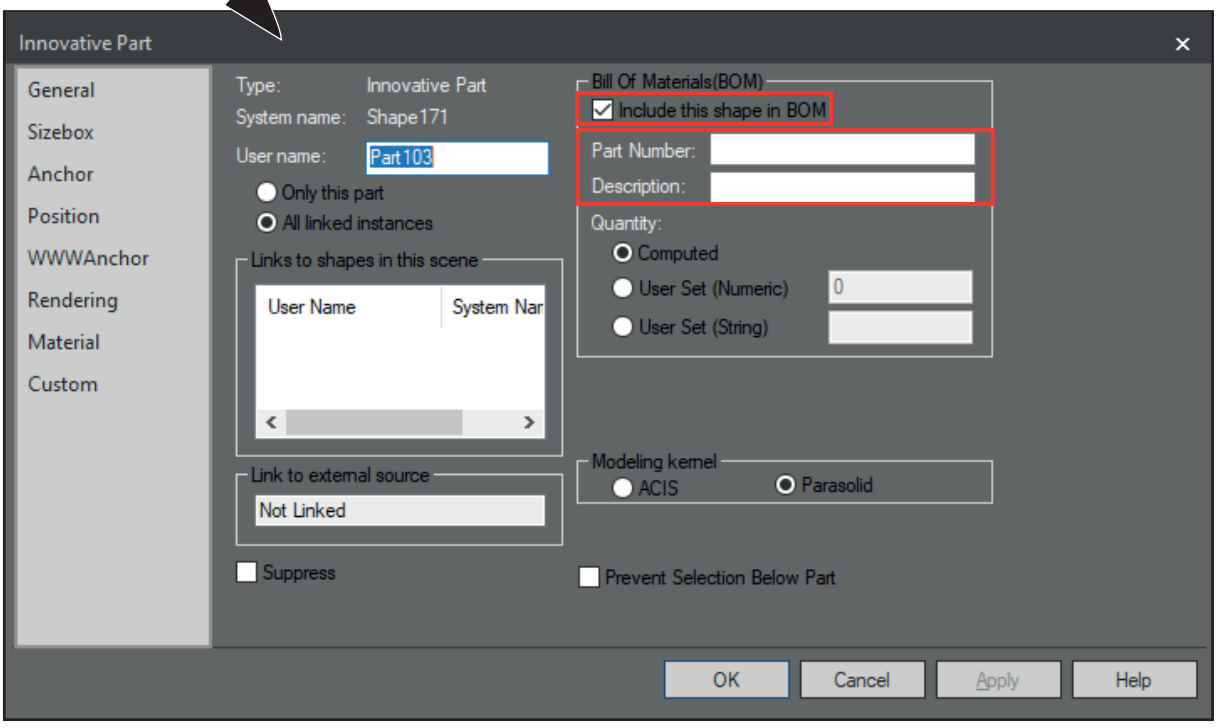
Select a file location and name for the document and click **Save**. This will launch an HTML document with build instructions, images of the fixture, and also a bill of materials. The HTML document can then be printed or saved as a PDF through the internet browser screen.



The bill of materials (BOM) in the Build It document will also make reference to your work piece. If you want to edit the name of this, select the part, right-click on it and then select **Part Properties**.

Within this window you can either rename your part with a specific part number and description, or you can untick the **Include this shape in BOM** check box to remove from the Build It.

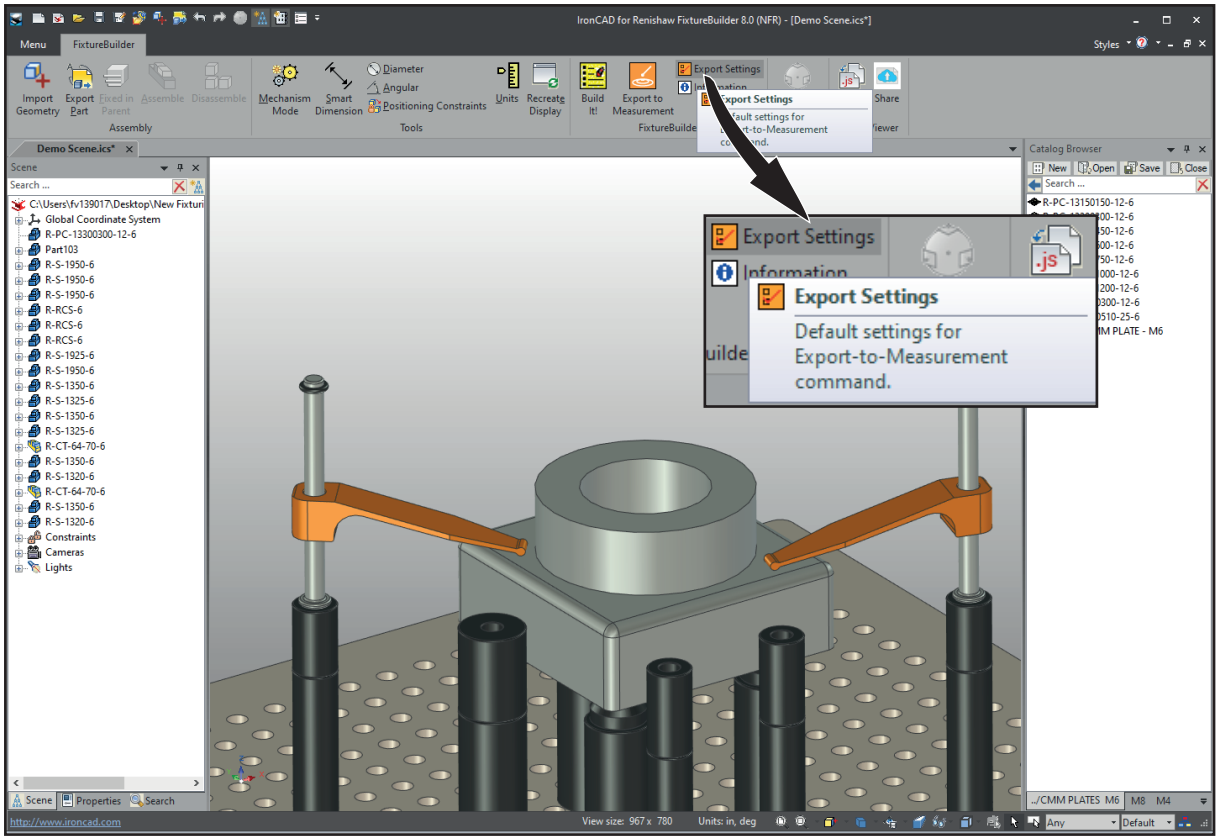




11. Exporting to measurement

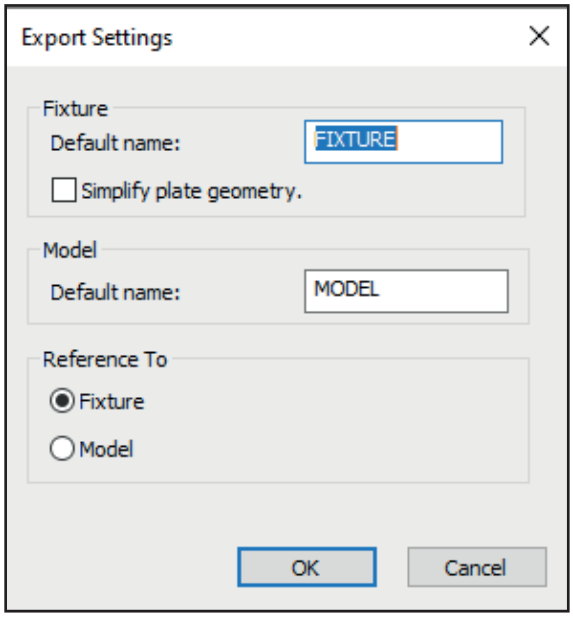
The fixture can be exported in a number of different formats which can then be used for offline programming. The fixture and the model will be exported in two separate files.

To configure your fixture and part for export, click on **Export Settings** on the ribbon bar.

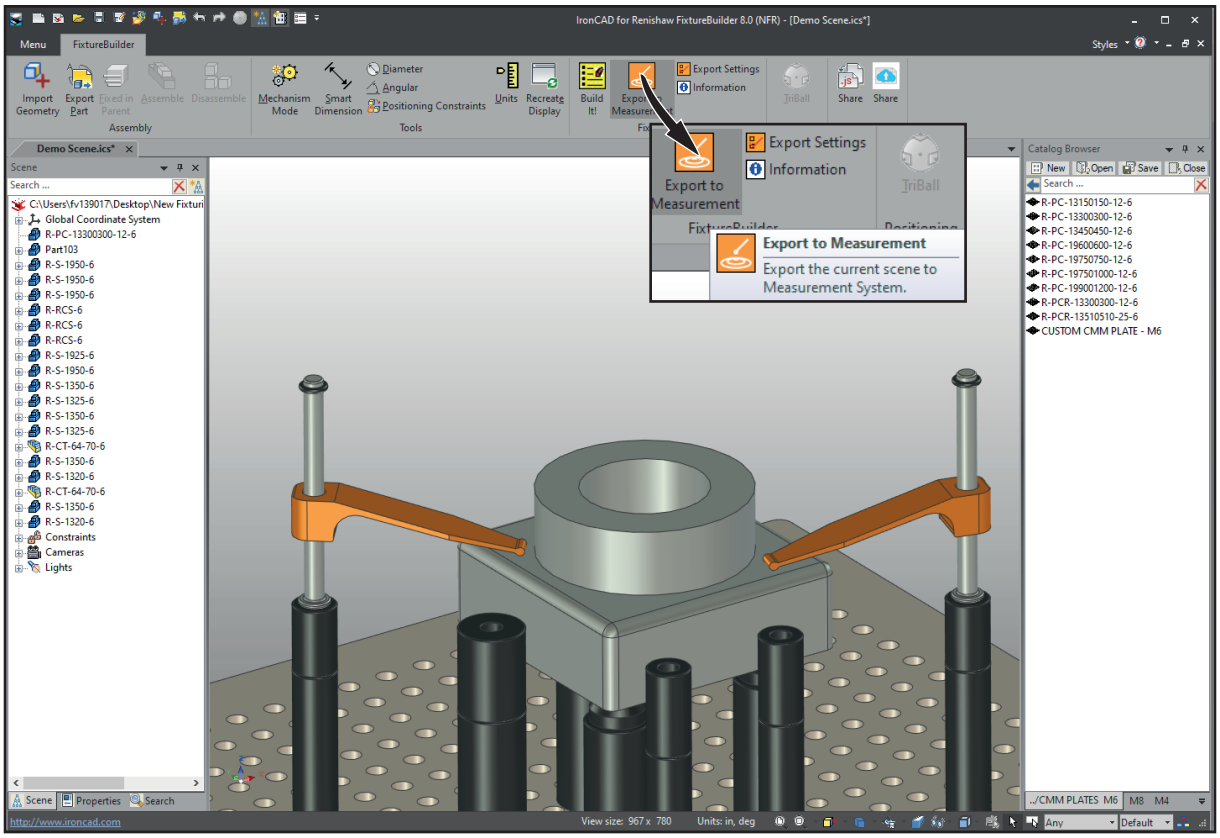


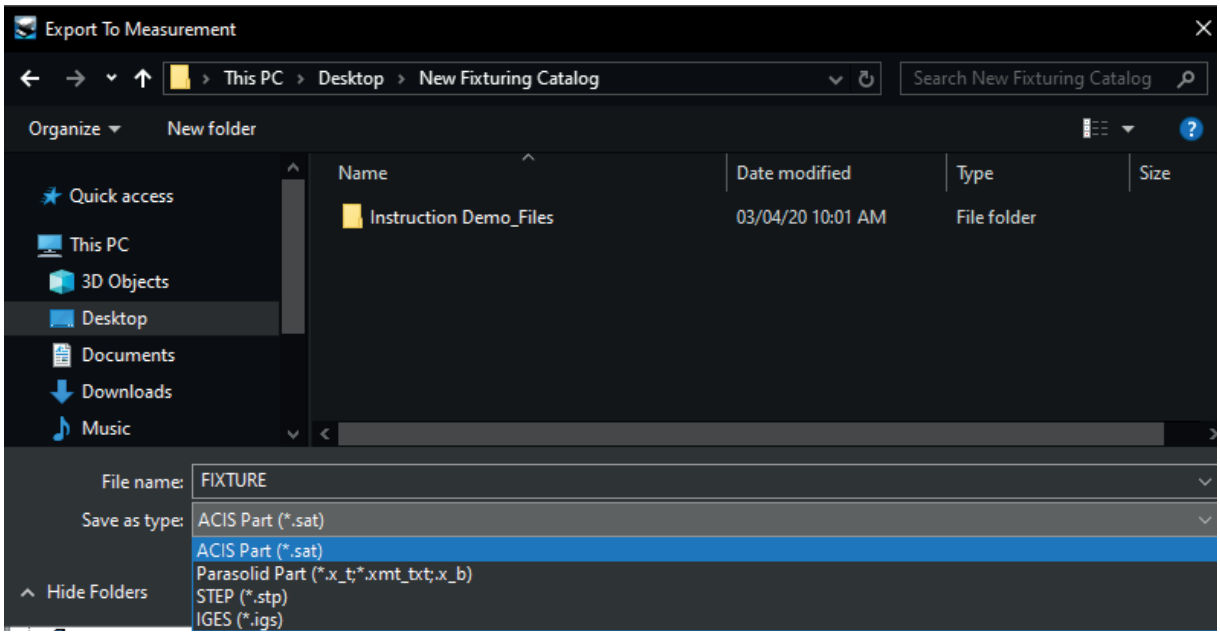
Note: The co-ordinate system of the fixture or the model will match the co-ordinate system of the Measurement Machine software.

Tip: Adjust or orient the fixture or model co-ordinate system in FixtureBuilder before exporting.



Next, to export the fixture and the part, click on "**Export to Measurement**" on the ribbon bar.

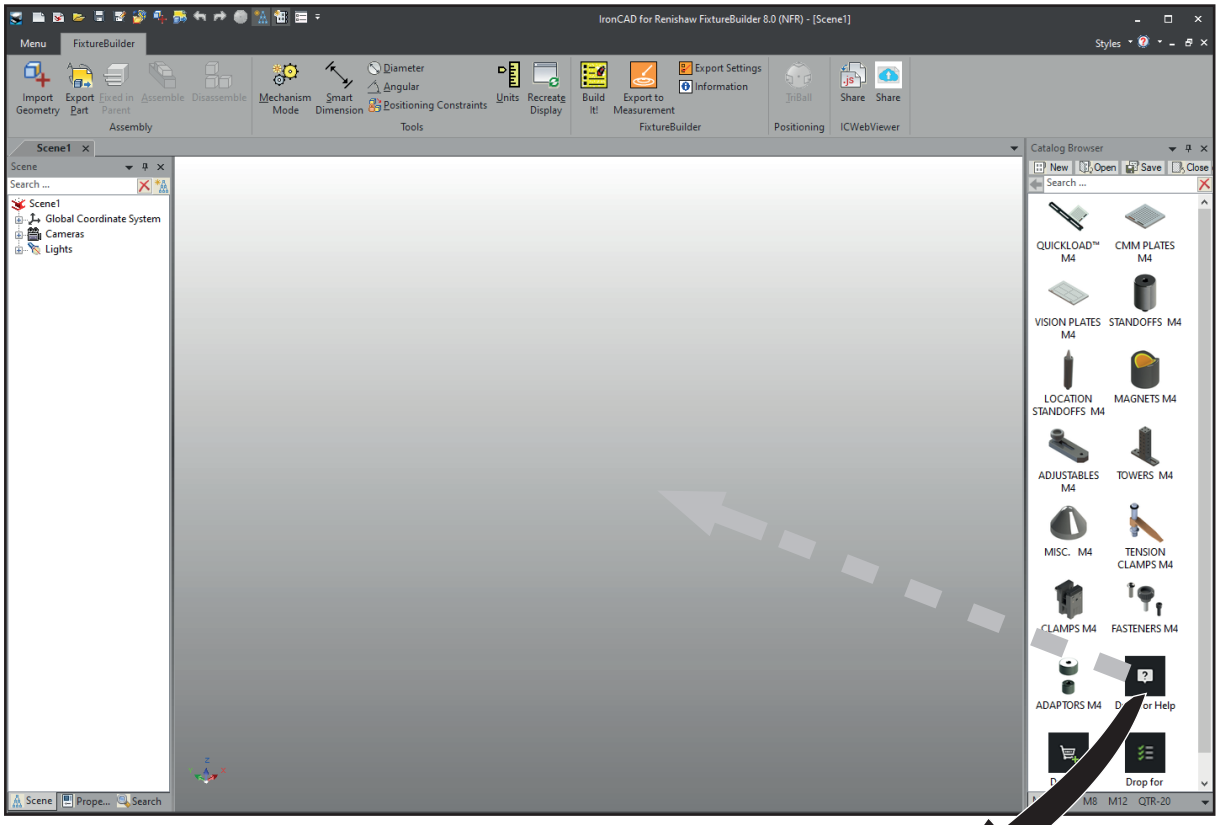


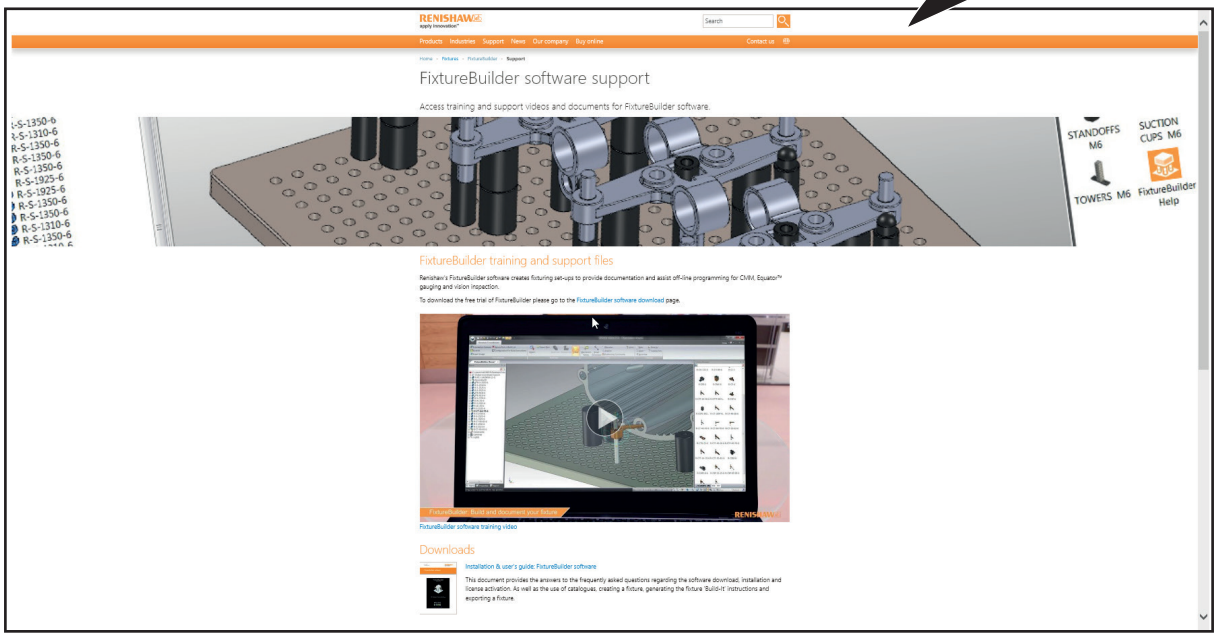


12. Drag and dropping web links within catalogues

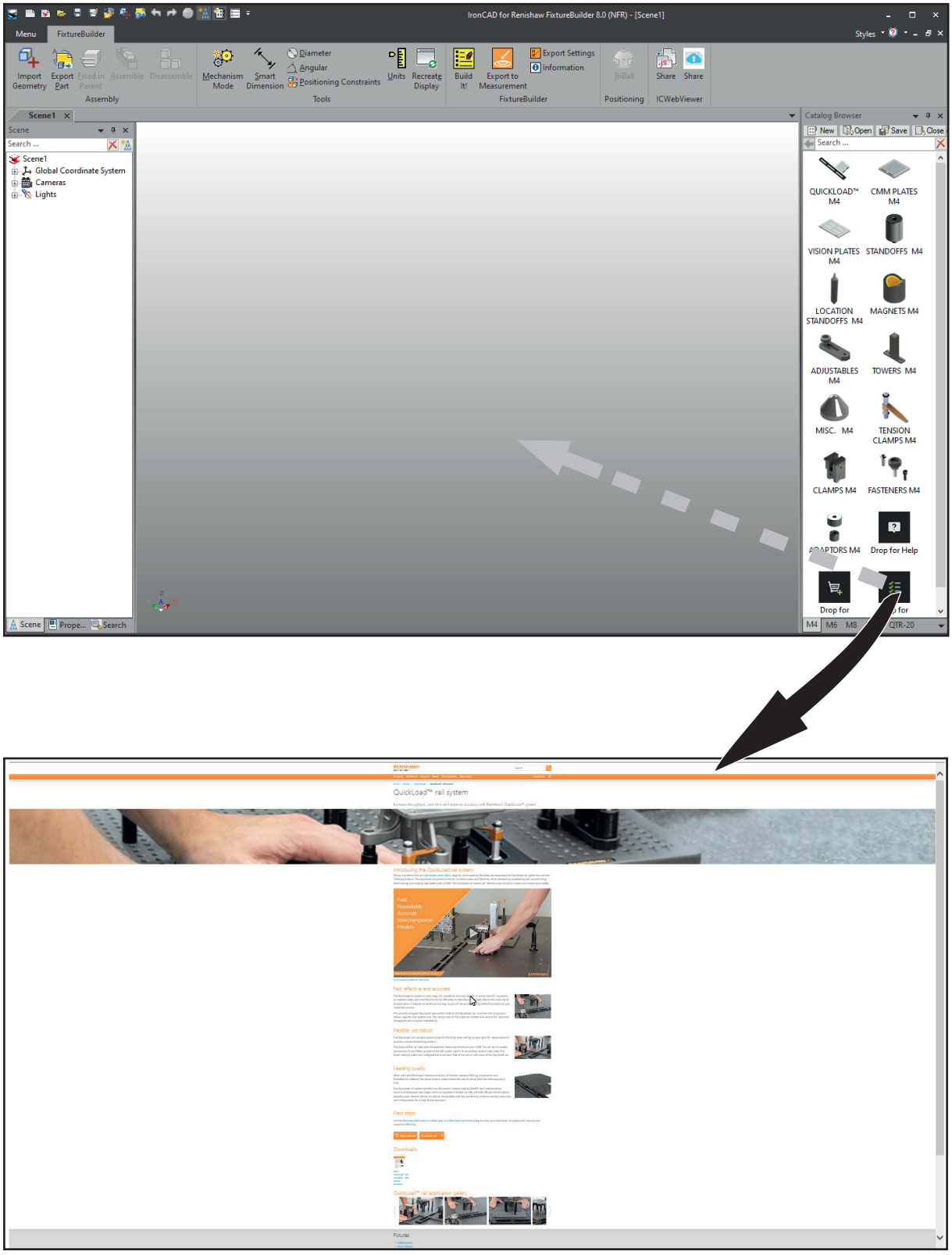
You can now drag and drop the web link logos into the scene to open the web page for additional information.

Example 1





Example 2


IronCAD for Renishaw FixtureBuilder 8.0 (NFR) - [Scene1]
Menu
FixtureBuilder
Import Geometry
Export Part
Fixed in Parent
Assemble
Disassemble
Assembly
Mechanism Mode
Smart Dimension
Diameter
Angular
Positioning Constraints
Units
Recreate Display
Tools
Build It!
Export to Measurement
Export Settings
Information
FixtureBuilder
TriBall
Positioning
Share
Share
ICWebViewer
Scene1
Scene
Search ...
Scene1
Global Coordinate System
Cameras
Lights
Catalog Browser
New
Open
Save
Close
Search ...
QUICKLOAD™ M4
CMM PLATES M4
VISION PLATES M4
STANDOFFS M4
LOCATION STANDOFFS M4
MAGNETS M4
ADJUSTABLES M4
TOWERS M4
MISC. M4
TENSION CLAMPS M4
CLAMPS M4
FASTENERS M4
ADAPTORS M4
Drop for Help
Drop for
M4
M6
M8
QTR-20

QuickLoad™ rail system

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H-1000-0211-03

Issued: 06.2020

Part no. H-1000-0211-03-A