**Easy Fill Advanced User Manual**

**V2.0**

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# Set Working Folder

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| This section demonstrates how to set working folder.  Attribute of molding components and analysis result will be saved to the working folder.  This is optional, and the system will set current work part folder as working folder if user does not specify one. | |
|  | Click **Set Working Folder** in the ribbon. |
|  | Click **Browse…** to select working folder.  Click **OK** to confirm your settings. |
|  | If there already exists data in the selected working folder, the massage will show up. |
| The attribute of molding components is saved as a .XEDS file, including the path of analysis result folder, with the same name as model file. | |

# Set Cavity

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| This section demonstrates how to set up a part and relating parameters. | |
|  | Click **Set Cavity** in the ribbon to start setting. |
|  | Click **Select Body** and then click on your model to make selection |
|  | Click **Select Material** to activate Moldex3D Material Wizard. |

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|  | Select a material from the pull down list and click **OK**.  If the complete Moldex3D Material Bank is needed, click on **Advanced…**. |
|  | Click **OK** to apply the settings. |
|  | **How to manipulate Moldex3D Material Bank**  By clicking on **Advanced…** of material wizard, users can access Moldex3D Material Bank. |

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|  | Click **Moldex3D Bank** on the left panelto load Moldex3D material bank. Find the material for the plastic melt**.** |
|  | Right-click the target material and click **Add to Project** in the context menu. Click **OK** in thepop-up confirmation. In the next pop-up dialog, click **Yes** to add the material to User Bank. |

# Create Runner System from Solid Bodies

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|  | Click **Set Runner** in the ribbon to set up runner.  Click **Specify Runner** to set object with the runner attribute. It is supported to specify either solid runner or line runner. |
|  | Click on the target solid object and click **OK** to confirm the selection. |

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|  | Specify runner type and click **OK** to confirm.  To modify runner design such as shape and sizes, use CAD functions. |
|  | An entity representing the solid runner will appear in the tree menu, double click to change runner type or click **delete** button on the right side of the list to delete. |

# Create Runner System from Line Elements

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|  | Click **Set Runner** in the ribbon to set up runner.  Click **Specify Runner** to set object with the runner attribute. It is supported to specify either solid runner or line runner. |
|  | Click on the target line object and click **OK** to confirm the selection. |

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|  | Specify runner attribute, type and diameter and then click **OK** to apply. |
|  | To modify an existing runner segment, double click its entity in Runner List, or click delete button on the right side of the list to delete. |

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|  | After change runner attribute, shape and size, click **OK** to confirm the settings. |

# Valve Gate Control

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| This section demonstrates how to set up valve gate control in hot runner attribute. | |
|  | Select Hot Runner for runner attribute.  Click **Valve Gate Setting** to access valve gate control settings. |
|  | Specify whether trigger by Melt Front (melt front position) or Time (filling time). |

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|  | **Triggered by Time**  Specify the gate action to open or close, and set the delay time.  Click **Add** to add a new control point.  Click **Modify** to modify a new control point.  Click **Delete** to delete an existing control point. |
|  | **Triggered by Melt front**  Enter coordinates or click  to select a specify point for trigger point.  Select the gate action, open or close, and set the delay time.  Click **Add** to add a new control point.  Click **Modify** to modify a new control point.  Click **Delete** to delete an existing control point. |

# Create Melt Entrance

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| Melt entrance is essential to the simulation. This section demonstrates how to set up the melt entrance in the model. | |
|  | Click **Set Melt Entrance** in the tree menu to define a melt entrance.  Click **Specify Melt Entrance Position** to create melt entrance and click **OK** to proceed. |
|  | Click on the surface of runner or part to create melt entrance and click **OK** to proceed. |

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|  | An entity will appear in the list upon completion of set-up.  Double click the item in the list to modify any previous settings, or use the delete button on the right side of the list to delete. |
|  | **Note:** if the melt entrance is directly set on the part, the diameter of the melt entrance is adjustable. |

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| There are some differences among building melt entrance on the runner with solid bodies, on the runner with line element, by runner wizard, and directly on the part surface. Building melt entrance on the runner with line element is the same as using runner wizard to create melt entrance, which its diameter is defined by that of runner end point. The melt entrance on solid body is defined by the surface area of runner end. In addition, a complete runner system, including gates and runner, is prerequisite for creating melt entrance on solid body. Users also can add melt entrance directly on the part surface, and the diameter is defined by that of a hypothetical gate on the cavity surface. The comparison table is shown below.   |  |  |  |  | | --- | --- | --- | --- | | **Building melt entrance on the runner with line element** | **Building melt entrance by runner wizard** | **Building melt entrance on the runner with solid bodies** | **Building melt entrance on the part surface** | | Its diameter is defined by it of runner end point | Its diameter is defined by it of runner end point | Its diameter is defined by the surface area of runner end | Its diameter is defined by the diameter of a hypothetical gate | |  |  |  |  | |

# Parting Direction

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| A customize mold open direction function. | |
|  | Click **Set Parting Direction** on the ribbon to open the setting dialogue.  **Type**  Select from many types of direction vector selection.  **Vector Orientation**  Use **Reverse Direction** to flip the parting direction.  Click **OK** to apply the setting. |
|  | The specified parting direction will be shown in orange arrow. |
|  | The runner wizard will synchronize the parting direction and generate runner system based on the parting direction. |

# Run Analysis

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| This section will demonstrate the analysis setup in default settings. Before starting an analysis, please make sure all the model components of injection molding are properly set. | |
|  | After setting up all the model components, click **Start Analysis** on the ribbon  There are four sections in the analysis setup dialog: Analysis Sequence Setting, Process Condition, Project Setting, and Mesh Level.  By checking **Add to batch run**, current simulation model and process condition will be appended to the batch run after you click **OK**. Alternatively, you can click **OK** with unchecked **Add to batch run** to start calculation immediately. |

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|  | **Analysis:**  Choose the molding process you would like to simulate from the pull down menu. |
|  | **Process Condition:**  The default process condition is set by system based on the cavity dimension and the selected material.  In this example, **Filling Analysis** is chosen; Only Filling time, Melt temperature and Mold temperature can be modified. Packing time is adjustable once the Analysis Sequence is selected as **Filling&Packing** |
|  | **Project Setting:**  If needed, add descriptions on the task as a remark. |
|  | **Mesh Level:**  Users are able to choose the mesh level. The default mesh level is level 3; a higher mesh level means a denser and larger number of elements with better analysis accuracy.  In this section, you can also choose to use ensured enough mesh layers. This function will ensure enough mesh layers during the mesh generation process. This will make the simulation more accurate, but a larger number of mesh elements will be created.  More details are provided in the section, **Mesh Level Control**,. |
| After setting above-mentioned process conditions, click **OK** to start or click **Cancel** to cancel it.  Alternatively, Check the **Add to batch run** before clicking **OK** to generate the mesh but no to start simulation. | |
| Analysis Monitor | |
|  | The analysis monitor shows the run ID, analysis sequence, estimate time, calculation percentage, and status.  Analysis log shows the calculation data of the current run.  To control the calculation process, use the button on the bottom of the monitor:  Use the **Remove** to remove a selected analysis which is pending.  Use **Run** to start the pending run.  Use **Stop** to abort the calculation.  Use **Close** to Abort the calculation and close the monitor. |

# Mesh Level Control

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|  | In the meshing control panel, there are five levels of meshing available to choose. In general, you can move the control panel toward left to reduce element counts and thus speed up the calculation. On the other hand, to have more accurate computation result, move the control bar toward right side to have dense elements. |
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| **Comparison Table**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Mesh Level** | Fast Default Accurate | | | | | | 1 | 2 | 3 | 4 | 5 | | **Element Count** | ~ 150K | ~ 150K | 300K ~ 600K | 600K ~ 1.5M | 800K ~ User-defined | | **Ensure Layer** | V | V | V | V | V |   a | |
| **More details about the Accuracy Level are described in the followings:**  **Level 1:**  This is the most recommended level for the user who wants to have a quick filling analysis result. In most cases, the solid mesh generated in this level is applied for demo purpose. Under this level, the program generates the solid mesh with fewer elements and performs CAE analysis with higher acceleration ratio.  **Level 2:**  This is the recommended level to do general filling/packing simulations for normal mechanical parts. Under this level, the program generates the solid mesh with slightly fewer elements and performs CAE analysis with general settings.  **Level 3:**  This level is set to be the default, designed to do general filling/packing simulations with better resolutions for normal mechanical parts.  **Level 4:**  This is the advanced level for getting full injection analysis (filling/packing) for thin and complicated parts. Under this level, the program generates meshes more elaborate and performs CAE analysis accurately. However, it is to be noted that more hardware resources are required.  **Level 5:**  This is the most recommended level for getting in-depth analysis for all kind of parts. Under this level, the program generates meshes more elaborate and performs CAE analysis accurately. If you want to have a further refined solid mesh, you can do it by modifying the target number of elements in the Options dialog. However, it is to be noted that more hardware resources are required. | |

# Show Result

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|  | After analysis finished, click **Show Result** in the ribbon to open the dialogue. |
|  | Click on the run you want to view, or use the delete button on the right side of the list to delete.  There are six sections in the Show Result Dialog: Analysis Result, Display Result, Display Setting, Animation Setting, Views Tool, Save Animation as Files, and Advanced Control. |
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|  | **Criteria**  Check if each result is out of user defined limit range.  **Display Mode**  User can change it to customized mode for only showing the result they care about by preference setting, or show all results by “Classic mode”.  **Analysis**  By using the Filling/Packing option, users can view the result of filling or packing stage.  **Result Type**  Expand the pull down menu to select the result you want to view. There around 30 result types, including Melt Front Time, Air Trap, and Weld Line…ect.  If the result is out of the criterion used, there is a warning sign “!!” shown before result name.  快照2507.PNG  **XY Plot**  Check the box to activate XY Plot and select the result in the pull down menu of XY Curve Type in which has 7 results. |

# Display Result - Criteria

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|  | **Criteria**  User can specify each result limit range.  Expand the pull down menu to select the criterion you want to use.  Click  to call result criterion setting dialog and specify each result limit. |
|  | **Result Criterion Setting**  The Result Criterion Setting dialog box shows as the following:  **Import from file**—Import the criteria setting file \*.xmrc.  **Result limit setting**—After clicking the result in list, the limit value group would be shown below. In limit value group, user can input upper/lower limit to be the constrain of the result.  User also can erase setting by clickingbutton.  **Export to file**—Export the criteria setting file \*.xmrc for other PC. |

# Result Advisor

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|  | **Result Advisor** quickly coordinates possible issues for this run. |
|  | **Result Advisor**  Click **Result Advisor** to view the problems detected in the analysis. The Result Advisor dialog box shows the following:  **Found Issues**—Lists the problems detected while performing the simulation. Click an issue to view its description, solution.  **Problem Description**—Displays a description for the selected problem with a conceptual animation.  **Suggested Solutions**—Displays appropriate resolutions for the selected failures.  Update the analysis as recommended in the resolution and rerun the analysis. |

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|  | **Display Setting**  This function enables users to adjust the upper and lower limits to set a specific range for analysis result. For example, temperature or shear stress in the part.  **Upper limits of display range**  **Lower limits of display range**  Use the slider to adjust the upper or lower limits of color legend.  Click **Reset Range** to reset the upper and lower limits with your preference.  Click **Cavity** to hide/show part.  Click **Runner** to hide/show runner. |

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|  | **Animation Setting**  Animation tools controls the play speed and display step. It helps you inspect results during the filling process or at specific filling percentage both on post and XY Curve.  Animation tools support some results and XY Plot:  **Percentage Step**  Click the arrow to enlarge or reduce the step percentage of each frame. The animation displays smoothly with low value of percentage step.  **Percentage**  Pull the control bar changes the melt front display during filling process. The post and the color legend will be synchronized when pulling control bar. |
|  | **View Tool**  Click a result item and check View Tools to enable view tools function.  There are three options, Clipping Function, Slicing Function, and Iso-surface Display.  **Clipping Function**  Referring to the plane equation: aX + bY + cZ = d, user can specify each parameter to define the clipping plane.  **Slicing Function**  Referring to the plane equation: aX + bY + cZ = d, user can specify each parameter to define the slicing plane.  **Iso-surface Display**  User can use this feature to view a specific value of result by adjusting the color legend. |

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|  | **Animation type**  Select the format of the animation, AVI or GIF.  **Time**  Specify the total length of the animation.  **Frames / sec**  Define frames per second. The larger number makes smoother animation but longer processing time.  **Range**  Users can make a partial animation by adjusting the range.  **Export animation file path**  Enter file name and specify the file path.  **Save Animation**  Click Make Animation to start recording. |

# Generate Powerpoint Report

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| After analyzing, analysis results such as melt front time animation, temperature distribution, pressure distribution can be coordinated as a powerpoint file. | |
|  | Click **Generate PowerPoint Report** in the **Advanced Control** tab. |
|  | **Create Report** – Report Information.  Fill the information to provide in the report, and click **OK**. The report will then be generated automatically.  The information items to be filled are:  **Title**  The title of the report.  **Author**  The author of the report.  **Company**  The company name that generates the report.  **Company Logo**  The company logo can be put in the report. And support the \*.bmp file type.  **Recipient**  The recipient of the report.  **Recipient Company**  The recipient company of the report.  **Report Path**  **Location**  The location of the report.  **File Name**  The filename of the report..  The automatic report will be done in several minutes. |

# Gate Wizard

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| Click on **Gate Wizard** in the ribbon. There will be a dialog popping up for users to set the gate types and other related parameters. | |
|  | **NX EasyFill Advanced** supports various gate types: Pin Gate, Sprue Gate, Edge Gate, Fan Gate, Lapped Edge Gate, Tunnel Gate, Cashew Gate, Tunnel Gate With Ejector Pin, and Cashew Gate With Ejector Pin.  Each gate can be set to Cold Runner Gate or Hot Runner Gate. Following are the step-by-step procedures for setting each gate: |

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| MWSnap085 | 1. **Pin Gate**   Step 1: Select **Pin Gate**.  Step 2: Click Select Point MWSnap083 and select the point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as left. Set related parameters, such as diameter of cross-section and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |
| MWSnap087 | 1. **Sprue Gate**   Step 1: Select Sprue Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as diameter of cross-section and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |

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| MWSnap088 | 1. **Edge Gate**   Step 1: Select Edge Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as the width and length of cross-section, orientation vector and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |

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| MWSnap093 | 1. **Fan Gate**   Step 1: Select Fan Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as the width and length of cross-section, orientation vector and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |
| **Note:** While selecting Fan Gate, there is an additional option, **To Nearest Edge**, shown at the bottom of setting panel.  Check **To Nearest Edge**, and the gate will automatically move to the nearest edge from the location you selected. | |

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| MWSnap095 | 1. **Lapped Edge Gate**   Step 1: Select Lapped Edge Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as the width and length of cross-section, orientation vector and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |

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| MWSnap097 | 1. **Tunnel Gate**   Step 1: Select Tunnel Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as diameter of cross-section, orientation vector and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |

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| MWSnap099 | **Note:** The cross-section can be designed as circular or rectangular by clicking **Type** drop down menu shown in the setting panel. Set corresponding parameters, such as dimensions of cross-section, orientation vector and gate length as in circular type. |

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| MWSnap101 | 1. **Cashew Gate**   Step 1: Select Cashew Gate.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. Set related parameters, such as the diameter of cross-section, orientation vector and gate length. After setting, click **OK** to confirm and exit the setting or click **Apply** to set next gate. |

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| MWSnap103 | **Note:** The cross-section can be designed as circular or rectangular by clicking **Type** drop down menu shown in the setting panel. Set related parameters, such as dimensions of cross-section, orientation vector and gate length as in circular type. |

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|  | 1. **Tunnel Gate With Ejector Pin**   Step 1: Select Tunnel Gate With Ejector Pin.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. There will be two parts of setting parameters. The top part is for Tunnel Gate setting; the bottom is for Ejector Pin setting. After setting related parameters, click **OK** to confirm and exit the setting or click **Apply** to set next gate.  MWSnap105 |
|  | **Note:** There are three types of ejector pin, Rectangular, Semicircular and U-shaped, for users to select from. |
|  | 1. **Cashew Gate with Ejector Pin**   Step 1: Select Cashew Gate With Ejector Pin.  Step 2: Click Select Point MWSnap083 and select the face or point on model surface as the gating location.  Step 3: A gate parameter setting panel will pop up as shown. There will be two parts of setting parameters. The top part is for Cashew Gate Setting; the bottom is for Ejector Pin. After setting related parameters, click **OK** to confirm and exit the setting or click **Apply** to set next gate.  MWSnap108 |
|  | **Note:** There are three types of ejector pin, Rectangular, Semicircular and U-shaped, for users to select from. |

# Melt Entrance Wizard

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| You can start auto melt entrance command in the ribbon.  Click **Melt Wizard** to start Melt Entrance Wizard. |
| After clicking it, melt entrances will be added to the runner system automatically and the melt entrance can also be set directly on the gate as below. |

# Runner Wizard

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| Runner Wizard automates the runner system design process by generating a knowledge built-in runner system. When designing the runner system, users have to set only gate location and dimension on the model, and the wizard will calculate for proper runner sizes, shapes and layout. It also support to generate a complete runner system by specifying runners, sprue, and drops sequentially. With Runner Wizard, users can design runner systems more efficiently.  MWSnap120 |
| You can start runner wizard command in the ribbon.  Click on **Runner Wizard** to launch Runner Wizard. |
| **Note:** it requires defining gates before running the wizard, or the following warning would be shown.    Click the Mold Setting tab. The explanation of each parameter is described below: |

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|  | **Parting direction:**  Parting direction is available in positive and negative X, Y, and Z directions.  **Mold Plate Type:**  Select the mold plate type; there are 2-Plate mold and 3-Plate mold available.  **Using:**  The wizard offers four options to specify the position of main parting plane: Top of part, Bottom of part, Gate plane and Custom.  **PL1:**  Define the main parting plane position. (Modify only in Custom using type)  **PL2:**  Define the secondary parting plane position  **PH:**  Distance between main parting plane and secondary parting plane |

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| The Sprue Settings tab of the wizard is for specifying the sprue position, sprue length and sprue diameter. The explanation of each parameter is described below: | |
|  | Select the sprue position from the drop down list. There are two options available: Center of gates and Custom.   * Center of gates: Position the sprue at the center of gates. * Custom: Specify a custom sprue location. Please enter values for sprue location in the X, Y and Z text box, or left- click in the graphic window to specify desired sprue location. |
|  | **Sprue Geometry Parameters**  **D1:**  Specify the diameter of sprue start.  **D2:**  Specify the diameter of sprue end.  **SH:**  Specify the length of sprue.  **CL1:**  Specify the length of cold slug well.  **CLD:**  Specify the diameter of cold slug well.  **Use cold slug well:**  If users want to use the cold slug well for sprue, make sure this option is checked. |
|  | **Runner Setting**  **Type:**  Define the cross section type of runners. There are Circular, Trapezoidal, Semicircular, and U-shaped available.  **D:**  Specify the diameter of runner.  **Use cold slug well:**  If having the cold slug well for runner, make sure this option is selected.  **CL2:**  Specify the length of cold slug well.  **D3:**  Specify the diameter of drop start.  **D4:**  Specify the diameter of drop end. |
|  | **Extended Gate Parameters**  In some specific locations, the runner setting has option to use extended gate, and specify the values of L (length) and D (Diameter) of the extended gate. Users can use extended gate function to avoid unreasonable runner creation.  An example is shown below: |

# Cooling Time Indicator

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| This tool can estimate the cooling time of cavity.  After the attribute setting process of part, you can find the **Cooling Time Indicator** icon enabled in the Tools menu. Within one click, the result of estimated cooling time will show up in the display window. |
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|  | At the same time, Material Information and Parameter Setting will be displayed on left. The calculation of estimate cooling time is based on the corresponding information. Besides, users can use the slider to adjust upper and lower limits of color legend manually. |

# Flow Length to Thickness Ratio Indicator

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| After gate or melt entrance setting is done, click **L/t Indicator** in the Indicator Tool.  Pull the Upper/Lower Limit Slider to specify the range of the Flow Length/Thickness. |
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# Gate Location Adviser

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|  | After part setting is done, click **Gate Location Advisor** in the category of indicator tool.  Select gate number (up to 6 gates).  Set parting direction of the mold base.  Click  to calculate the suggested gate location(s).  After calculation, click  to add pin gates on the suggested gate location(s). |
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# Sink Mark Indicator

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| This tool can estimate the location of sink mark.  To use this function, users must finish part attribute setting and make sure that both runner and melt entrance attribute exists (at least one attribute each). | |
|  | After the attribute setting, click on **sink mark Indicator**. Within one click, the result of Sink Mark will show up on the display window. |
|  | Sink Mark usually occurs at rib or corners of cavity. |
|  | Parameter Setting will be displayed on left. Users can use the slider to adjust upper and lower limits of color legend manually. |

# Upload to Teamcenter/Download from Teamcenter

|  |  |
| --- | --- |
| If NX is opened via Teamcenter, it is available to upload the analysis result to Teamcenter or download the analysis result from Teamcenter.  On the other hand, the analysis result opened directly from local disk and can only be saved to the local disk.  Note: The following functions will respond only if NX is opened via Teamcenter. | |
|  | After analysis finished, click **Upload to Teamcenter** and the analysis result will be uploaded to the corresponding folder in Teamcenter. |
|  | Click **Download from Teamcenter** and the analysis result will be downloaded to the working folder in your local disk. |

# Set Preference

|  |  |
| --- | --- |
| After click “Preference” on ribbon, therewill pop up a dialog. It help user to filter the result for what user care about and need to view. It also provides that user can import \*.xmrg file, or export setting file to other project. | |
|  | **Customized Result Display**  Users can set result list what they need to check ; after click OK button, result shown in “Show Result” dialog would be changed.  **Import**  User can import \*.xmrg file in the group.  **Customized Result Display Setting**  User may change analysis type, select the result and click  button, then the selected result would be added to customized list.  User also can set priority by   button, and delete the result in customized list.  In addition, customization can modify by add button , rename button  and delete button.  **Export**  After setting, user can export \*.xmrg for other project. |

# Results

## Air Trap

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| Air Trap result shows the possible locations that air trap could have occurred. |

## Average Temperature

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| --- | --- |
| This result shows the average temperature in the thickness direction at current time step. | |
| avd1 | Each average temperature value shown on the cavity surface is calculated by averaging the temperature values on a certain number of unevenly-spaced points along the thickness direction; the temperature values on these points are interpolated from their adjacent nodes. |
| The equation for calculating the average temperature is shown below:  Assuming the gap-wise direction is  , where t is the thickness of the cavity, and T is the temperature of the melt.  It considers the effect of mold cooling and viscous heating of melt. Therefore, average temperature can represent the part temperature.  You can use this result to examine if there is any hot spot that could cause burning problem or short shot due to flow hesitation or excess mold cooling. | |

## Bulk Temperature

|  |
| --- |
| Bulk temperature is the velocity-weighted average melt temperature in the thickness direction at current time step. |
| The equation for calculating the bulk temperature is shown below:  Assuming the gap-wise direction is  , where t is the thickness of the cavity, v is the velocity of the melt, and T is the temperature of the melt.  In this result, the temperature contribution from frozen layer is neglected. The effect of heat convection and viscous heating can be observed from this data. Therefore, it can clearly demonstrate how heat convection affects the temperature distribution of hesitation and viscous heating area.  In general, bulk temperature distribution can reflect the trend of flow and therefore the actual path of pressure transmission. |

## Cavity Weight

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| --- |
| This result shows the plots of cavity weight versus filling time.  You can use this result to check flow contribution balance across multiple cavities if the simulation involves more than one cavity. |

## Center Temperature

|  |  |
| --- | --- |
| Center temperature result shows the center melt temperature in the thickness direction at current time step.  The center temperature is calculated by interpolating from the temperature values of the nodes that forms the element at the center of the path along the thickness direction. | |
| mesh cent | * The red dot shows the middle point of the gap-wise path. * The nodes shown in blue are taken into interpolation of the center temperature. * Note that this diagram does not show nodes in the direction normal to this view. |
| Center temperature is an indicator of thermal energy supply of the fresh hot melt.  The possible flow hesitation or short shot can be identified if the center temperature is too low. | |

## Clamping Force

|  |
| --- |
| This result shows the plots of clamping force versus filling time.  Note that this value is the calculated required clamping force; it is not the force that molding machine outputs.  You can use this result to identify possible flash problem. From past experience, if the calculated clamping force is larger than 70% of machine maximum clamping force, there is a good chance that plastic melt will be squeezed outside the cavity and cause flash. |

## Cooling Time

|  |
| --- |
| This result shows the time estimated from EOP to the instant that molded part temperature has been cooled down to the eject temperature.  A reasonable Cool Time setting is essential in process conditions to make this calculation more representative and meaningful.  Generally, thicker region requires longer cooling time. |

## Density

|  |
| --- |
| Density result shows the density distribution of plastic at current time step.  In general, frozen region will have higher density and molten region will have lower density.  Non-uniform density distribution can cause warpage of the finished part. |

## Flow Rate Gate\_#

|  |
| --- |
| This result shows the plots of flow rate at a gate versus filling time.  You can use this result to:   * Examine shear heating effect by looking for high flow rate at the gate. * Check flow contribution of each gate. Unbalanced gate contribution could lead to weld line problems. |

## Flow Rate

|  |
| --- |
| This result shows the plots of flow rate at the sprue versus filling time.  In most cases, the first stage of filling is controlled by the flow rate set by the machine operator. Therefore in this result, the flow rate usually stays at the value set in the process condition of Moldex3D. If the resulting flow rate appears otherwise, you need to check if the maximum allowed injection pressure is too low. |

## Frozen Layer Ratio

|  |
| --- |
| Frozen Layer Ratio result shows the volume percentage of frozen plastic with respect to part thickness at current time step. This value will reach 100% as time passes by. |
| The picture and the equation below explain how frozen layer ratio is calculated.  fdsdsfsaf  Blue: Frozen plastic melt  Yellow: Flowing plastic melt  , where is the thickness of the upper frozen layer, is the thickness of the lower frozen layer, and is the thickness of the cavity.  As the melt cools down during the injection processes, the solidification of the melt forms frozen layer near the cavity surface. The increase in the thickness of frozen plastic reduces the cross-section along the flow path and further increases the flow resistance and sprue pressure.  Because solidified plastic has higher resistance to deformation, the thicker the frozen layer is formed, the lower the chance of forming sink marks, but higher the chance of forming voids. |

## Gate Contribution

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| Gate Contribution result shows the volumetric contribution from injected plastic melt of each gate at current time step. Note that the result values are shown in percentage. Normally a balanced gate contribution is needed for obtaining optimized results. |

## Max. Cooling Time

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| --- |
| Shows the maximum cooling time in the thickness direction of the part. This is an estimated value based on filling result. |

## Max. Shear Rate

|  |
| --- |
| This result shows the recorded peak value of shear rate of each element during the filling stage. Note that the maximum shear rate values shown in this result are not necessarily in the same time step.  Shear rate is the rate of shear deformation of the material during the polymer processing. Shear rate distribution is related to the variation of velocity gradient and molecular orientation. High shear rate tends to drastically deform molecular chains even to break and then weaken the strength of product. Viscous heating due to high shear rate also should be noticed. |

## Max. Shear Stress

|  |
| --- |
| This result shows the recorded peak value of shear stress of each element during the filling stage. Note that the maximum shear stress values shown in this result are not necessarily in the same time step.  You can use this result to determine if the maximum shear stress in the finished part will exceed the maximum allowed shear stress. |

## Max. Temperature

|  |  |
| --- | --- |
| Max. Temperature result shows the maximum temperature in the thickness direction at current time step.  The maximum temperature is calculated by interpolating from the temperature values of all elements closest to the path along the thickness direction. | |
| mesh max temp | The nodes shown in blue are taken into interpolation of the maximum temperature.  Note that this diagram does not show nodes in the direction normal to this view. |

## Max. Volume Shrinkage

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| --- |
| Max. Volume Shrinkage shows the maximum volumetric shrinkage along thickness direction at current time step.  If this result shows locally high positive value, there might appear sink mark or void on the finished part depends on the thickness of frozen layer. |

## Melt Front Temperature

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| --- |
| Melt front temperature result shows the recorded temperature value of the plastic melt at the instant that it reaches the given point. Note that the temperature values shown in this result are not necessarily in the same time step.  From Melt Front Temperature, you can identify the following injection molding problems. |
| **Weld line**  To identify the possible location of the weld lines, it is common to use Melt Front Temperature result, cooperating with Melt Front Time result. The lower the melt front temperature at the meeting locations, the more noticeable the weld lines occurs.  The general solutions to the weld lines are described in the Melt Front Time result adviser. |
| **Flow Mark**  Flow mark is the surface defect that appears on the finished part near the gate. The defect is usually in the shape of ripple.  The cause of the flow mark is the low temperature of the material. The plastic melt will start to solidify while being injected into the cavity. It is the partially solidified material that produces the flow mark on the surface.  To check if there could be any flow marks, look for low melt front temperature in the runner and near the gate.  You can eliminate the flow mark by following methods:  Add cold slug well in the runner system to prevent cold material from entering the cavity.  Increase melt and mold temperature.  Decrease the runner diameter to increase frictional heating. |
| **Hesitation**  Hesitation is the condition where the flow significantly slows down along a particular path. Hesitation problem can be identified using Melt Front Time result. Incorporating with Melt Front Temperature result, it assist to check if the main cause is the low melt flow temperature.  The general solutions to the hesitation problem are described in the Melt Front Time result adviser. |
| **Material Degradation due to High Temperature**  Material degradation occurs when the melt temperature exceed the limit that the material can retain its integrity of the polymer structure |

## Melt Front Time

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| --- | --- | --- |
| Melt Front Time result shows the position of melt front with respect to time during the filling stage.  In general, an optimized Melt Front Time result should show balanced flow contribution of each gate and all flow path should reach the cavity wall at the same time. It is the most useful result in injection molding simulation since you can extract lots of information solely from Melt Front Time.  Possible issues that could be interpreted from Melt Front Time result are listed below: | | |
|  | **Hesitation**  Hesitation is the condition where the flow significantly slows down along a particular path. If the plastic flows too slowly and eventually stops before it completely fills the cavity, it is called short shot.  To check the occurrence of hesitation, look for slowly moving melt front in this result. | |
| To solve hesitation problem, you can:  Increase injection flow rate.  Increase mold temperature or melt temperature.  Change gate location.  Increase wall thickness where the hesitation occurred.  Use a different plastic material with higher MFI (Melt Flow Index). | |
|  | **Short Shot**  Short shot is incomplete filling of the mold cavity. When short shot occurs, extending the filling time will not solve the issue. | | |
| You can check the occurrence of short shot by looking for incomplete filling from Melt Front Time result.  To solve short shot problem, you can:  Ensure sufficient injection amount.  Increase injection flow rate.  Increase mold temperature or melt temperature.  Change gate location.  Use a different plastic material with higher MFI (Melt Flow Index).  Modify the thickness of cavity or the diameter of runner.  Improve venting. | | |

|  |  |
| --- | --- |
|  | **Weld line**  Weld line is the line formed by two different melt fronts joining together during the filling stage. It will decrease the strength of the final product and produce cosmetic defect. |
| To identify potential weld line positions, look for places that two melt fronts join together in Melt Front Time Animation result.  In most cases, it is very difficult to completely remove weld lines. One alternative solution is to move the weld line to area that does not require good strength and smooth surface. Another solution is to diminish the appearance of the weld line.  To move the weld lines, you can:  Change gate location.  Modify part thickness  To diminish the appearance of the weld line, you can:  Increase mold temperature or melt temperature.  Modify runner system design.  Reduce runner diameter to take advantage of frictional heating. | |
| **Air Traps**  An air trap is formed by converging melt fronts, trapping a small bubble of air. It may occur at multiple locations inside the cavity.  You can conclude that an air trap will occur at the location where melt front comes in all directions. | |
|  | **Overpacking**  During filling, injected plastic melt flows in several different paths depending on the cavity geometry and the gate location. With imperfect gate and runner design, each flow path does not have the same length or same cavity thickness, so some flow paths will be filled completely before others. These filled flow paths will keep being packed with extra plastic melt, called overpacking. |
| Overpacking could cause warpage due to non-uniform density distribution and PvT behavior.  To identify potential overpacking areas, look for flow paths that have shorter fill time in Melt Front Time result.  To solve overpacking problem, you should balance the flow paths by following methods:  Move the gate to a position that defines flow paths with similar length.  Balance the flow resistance in each flow path by thickening or thinning the cavity.  Add flow leader or deflector. | |
|  | **Racetrack effect**  As described in Overpacking, plastic melt in each flow path travels at different speeds. Because thicker wall region has lower flow resistance, the plastic melt tend to flow faster than thinner wall region. If the flow path is long enough, then backfill into thinner region may occur and further causes air trap and weld line. |
| To identify possible racetrack effect, check if there is any two adjacent flows travel at very different speeds from Melt Front Time result. | |

## Moldability

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| Moldability result shows the ease to fill locally. |

## Pressure

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| Pressure result shows the pressure distribution of the plastic at current time step.  From Pressure result, you can perform the following actions and modify design or analysis settings accordingly: |
| **Examine the pressure transmission situation**  **I**mproperly sized runner, gates, and cavity thickness limit the transmission of injection pressure to the cavity. Such limitation may lead to short shot since the force that’s driving the plastic melt is the injection pressure.  **Calculate runner system pressure drop**  To calculate pressure drop in the runner system, first you need to know the maximum pressure with and without runner which is:  *)* |
| **Avoid overpacking and flash of melt**  As mentioned previously, you can look for possible overpacking from Melt Front Time result. To predict overpacking more precisely, you can apply both Melt Front Time result and Pressure result.  Check the pressure value at the region that is likely to have overpacking. If the pressure is significantly higher than other region, the chance of that area having overpacking becomes higher. |

## Shear Rate

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| --- |
| Shear Rate result shows the distribution of shear rate in cavity at current instant with color scale. Shear rate is the rate of shear deformation of the material during the polymer processing. Shear rate distribution is related to the variation of velocity gradient and molecular orientation. High shear rate tends to drastically deform or even to break molecular chains which weaken the strength of product. High shear rate can also result in significant viscous heating. |

## Shear Stress

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| Shear stress result shows the shear stress distribution of plastic melt at current time step.  In optimized condition, the shear stress should distribute evenly. Non-uniform shear stress distribution might cause warpage of finished part. |

## Sink Mark Displacement

This result shows the possible sink mark displacement across the entire cavity surface. Higher value of this result indicates high degree of sink mark occurrence.

## Sprue Pressure

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| This result shows the plots of sprue pressure versus filling time.  You can use this result to look for any unusual sprue pressure rise during filling.  Often the sprue pressure will not exceed the maximum allowed injection pressure that is set in the process condition. If the resulting sprue pressure curve stays at the maximum allowed injection pressure, hesitation or even short shot might occur. |

## Temperature

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| Temperature result shows the temperature distribution of the plastic at current time step.  From Temperature result, it assists the following actions and modify design or analysis settings accordingly: |
| **Determine which region has high frictional heating**  Near the gates and low thickness region, the flow resistance becomes very high and can lead to frictional heating of the plastic melt. Simply check if there is any temperature rise near the gate and low thickness region from Temperature result.  **Check if the temperature variation corresponds to the process condition or design change**  In most cases, designers modify the product design or process condition to get optimized results. When you change, for example, wall thickness, the temperature distribution will change because thicker cavity is harder to dissipate heat to the mold. |

## Total Velocity

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| Total velocity result shows the distribution calculated from the norm of the velocity vector of plastic melt at current instant. This data can give the idea about how plastic melt flow at current instant. |

## Total Weight

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| This result shows the plots of total weight versus filling time.  Total weight is the weight of plastic melt inside the runner system and the cavity.  As the plastic melt is being injected into the cavity, the total weight increases until the cavity is fully filled. |

## Velocity Vector

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| --- |
| Velocity vector result shows the plots of the velocity vector at current instant. |

## Velocity

|  |
| --- |
| The X, Y, and Z Velocity result shows the X, Y, and Z component of velocity.  The negative value means the velocity in the opposite direction. |

## Viscosity

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| --- |
| This result shows the viscosity distribution of the plastic in the cavity at current time step. Viscosity is an important property in fluids to consider the resistance of flow.  In polymers, melt temperature and shear rate will influence the value of viscosity. The viscosity is constant at low shear rate, and decreases with increasing shear rate. Also, the viscosity decreases as temperature increases. |

## Volume Fraction

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| This result shows the plots of volume fraction versus filling time. The slope of the volume fraction curve represents the flow rate.  Volume fraction is the volume percentage of filled plastic melt. It will reach 100% as time passed by. |

## Volumetric Shrinkage

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| Volumetric shrinkage result shows the distribution of part volume change percentage as the part is cooled from high temperature and high pressure at current time step to ambient temperature and ambient pressure. This calculation is based on PVT relationship of the plastic material.  Positive value represents volume shrinkage while negative value represents volume expansion. For an optimized condition, uniform volumetric shrinkage is desired.  Therefore, the uniformity rather than the magnitude of the volumetric shrinkage is normally an important element. |
| Non-uniform volumetric shrinkage is caused by two reasons:  Non-uniform pressure distribution.  Non-uniform temperature distribution.  Non-uniform volumetric shrinkage can lead to two results:  Warpage.  Thermal induced residual stress if the stress did not transform into deformation. |

## Weld Line Meeting Angle

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| This result shows the distribution of meeting angle of melt fronts on weld lines.  Weld Line Meeting Angle is the meeting angle between two melt fronts, ranging from 0 to 135 degree, between two converging melt fronts. If the welding angle is 180 degree, then the two melt fronts can be considered as one. If the welding angle is 0 degree, then two melt fronts converge head-on. Generally, the smaller the meeting angle, the weaker the strength of the part becomes and the more obvious the weld line will be after the part is ejected.  MWSnap107 |

## Weld Line Temperature

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| This result displays temperature distribution on potential weld lines. Although increasing the temperature at the weld lines may diminish the appearance, it is recommended to hold this strategy as the last resort since increased melt temperature will likely aggravate the warpage. |

## Weld Line

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| --- |
| Weld Line result plots the potential position of weld lines and indicates potential spots of weaker structure. The darker the weld line, the weaker the structure. |