
# SOLUTIONS FOR PART DESIGNERS

White Paper

**Abstract**

For CAE analysis tools to be truly useful, they must provide practical information that drives design decisions. Moldflow Plastics Advisers® (MPA®) solutions enable users to predict and solve injection molding manufacturing problems in the earliest stages of product development.

The Moldflow Part Adviser module is an easy-to-learn, 3D solids-based plastics flow simulation product that allows part designers to determine the manufacturability and quality of their parts during the preliminary design stages and avoid potential downstream problems which can lead to delays and cost overruns.

This white paper describes the Moldflow Part Adviser module and how its capabilities benefit part designers.

*Moldflow Corporation • 430 Boston Post Road • Wayland, MA 01778 • USA*
*Tel: +1 508 358 5848 • Fax: +1 508 358 5868 • www.moldflow.com • www.plasticszone.com*

*01/04*

## CONTENTS

## INTRODUCTION

The Moldflow Part Adviser™ module is the ideal tool to quickly optimize part designs and check the impact of critical design decisions on the manufacturability and quality of the product when the cost of change is least — early in the design process. MPA products are easy to learn and use and do not require extensive training or plastics expertise. With the power of Moldflow's patented Dual Domain™ technology, users can work directly from 3D solid CAD models without the need to create or even view a finite element mesh, saving hours to days to weeks of model preparation time. In addition, Moldflow Part Adviser is integrated with the world's leading 3D CAD systems, allowing users to work directly from within their familiar CAD environment.

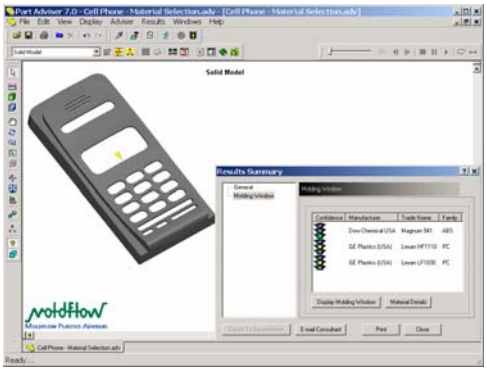
Users can get rapid feedback on how modifications to wall thickness, gate locations, material or geometry can affect the filling pattern and pressure and temperature distributions in the part cavity. The analysis results and detailed design advice can be used to determine the optimum part thickness and gate locations as well as to identify and eliminate cosmetic issues such as weld lines, air traps and sink marks. An automatic, Web-based report generator facilitates communication of results among all members of the design-to-manufacturing team.

To get started, launch the Analysis Selection Wizard. The Analysis Selection Wizard enables users to launch all MPA analyses from one location. The Analysis Selection Wizard clearly indicates what analyses are available and provides a brief description of each analysis. It also provides feedback about what input information is missing if a particular analysis cannot be launched. This key feature permits even first-time users of MPA software to become productive immediately.

## OPTIMIZE PART DESIGN MANUFACTURABILITY AND QUALITY

Moldflow Part Adviser analyses identify critical part-design manufacturability and quality issues and recommend appropriate actions to address those issues.1

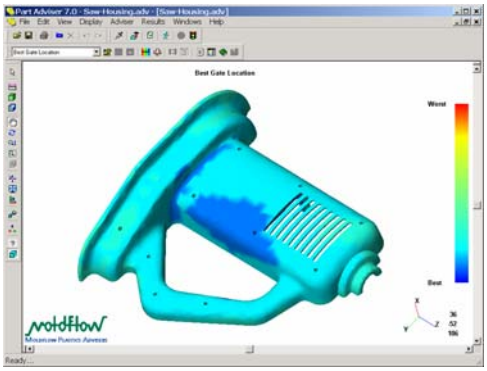
The first question users have when they want to perform a flow analysis on their model geometry is, “Which material is appropriate?” Moldflow Part Adviser features a Material/Process Adviser that allows users to identify the most suitable material for a part design among all potential materials. The designer can select all the candidate materials for the part design and then launch a Molding Window analysis, which compares the processability of each material and ranks the materials in the order of most suitable to least suitable.




*The Molding Window Analysis identifies the most suitable material for a given part design.*

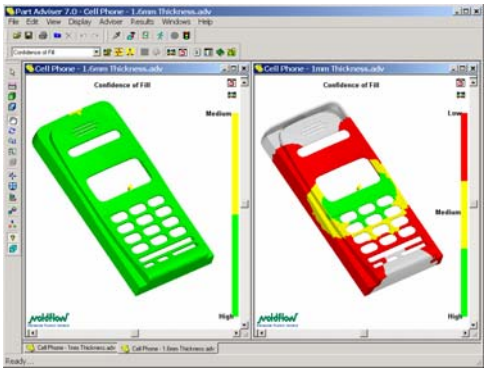
After a suitable material has been identified, the next crucial decision is with regards to the gate placement. With Moldflow Part Adviser, this task becomes a breeze through the help of the Gate Location Analysis. The output from this analysis is a color-coded display on the part geometry indicating the best and worst areas for positioning the gate. Detailed information is provided to give users real-time feedback on why the identified locations are good or bad.

1 The Moldflow Mold Adviser module provides additional mold-design capabilities that are described in the Solutions for Mold Designers white paper.



*The Gate Location Analysis identifies which areas of the part are the best locations for gating.*

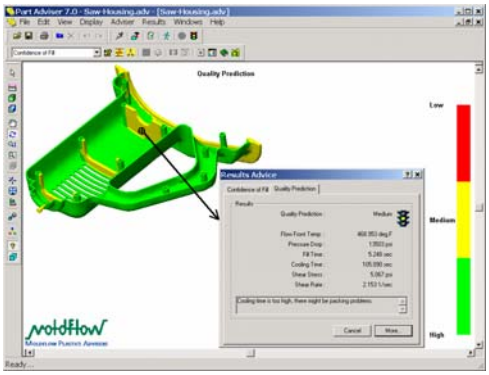
A fundamental design consideration for injection-molded parts is, "Can the part be manufactured?" In other words, this question seeks to answer whether the plastic will fill all sections of the part. The Moldflow Part Adviser software provides a design-specific output, Confidence of Fill, to answer this question straightforwardly. The results are plotted in a three-color display according to a traffic-light analogy: green indicates which areas of the part have high confidence of fill, yellow indicates some filling problems may occur, and red indicates areas that are not likely to fill. While the plot is simple and easy to interpret, the underlying technology used to create it is not. The Confidence of Fill predictions are based on an advanced analysis of cavity pressures, temperatures, and injection short shots.



*The Confidence of Fill plot highlights areas where filling problem may occur.*

Once a filling analysis is complete, the Moldflow Part Adviser software also provides a design-specific output to predict molded part quality using a similar green-yellow-red display. The Quality Prediction result accounts for flow properties (such as shear

stress, shear rate, cooling time, flow front temperature, and pressure drop) to determine which regions of the part may have quality problems. Part quality is an important variable for designers to consider, because even though a cavity may fill, excessive material shear, for example, may drastically reduce the mechanical strength of a molded part, which could cause premature part failure or a reduction in service life of the part.

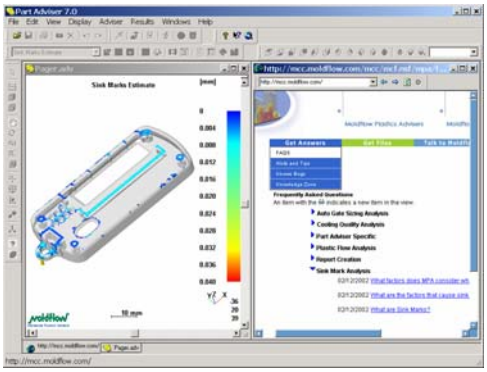



*The Quality Prediction plot highlights potential quality problems.*

Weld-line and air-trap locations can be superimposed over any other Plastic Flow Analysis result plot. Weld lines, in particular, may affect the visual quality as well as the structural properties of a plastic part. For example, looking at weld lines on an injection pressure plot will give some idea of weld-line integrity. If major weld lines occur in areas that fill under low pressure, these areas may be weaker than other areas of the part where no weld lines occur, or where weld lines form under high pressure. New in MPA 7.0 is the material orientation plot, which assists in determining a qualitative estimate of the part strength, especially in the vicinity of weld lines. Part designers can use the combined information from these two plots to evaluate design changes intended to move weld lines and air traps to less-sensitive regions of the part or to eliminate them altogether.

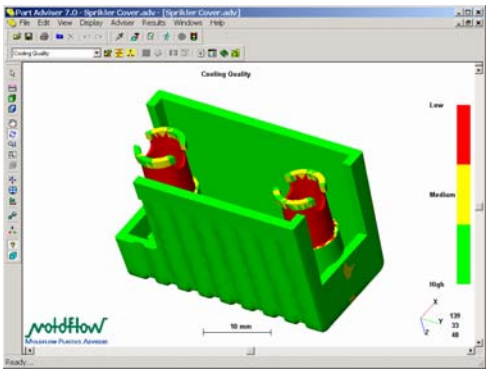
Moldflow Part Adviser features a unique capability in the form of the Sink Mark Analysis, which indicates the location and severity of sink marks. Sink marks are often associated with thick areas of a part, particularly on surfaces opposite to features such as ribs, bosses and gussets. Sink marks affect the visual quality of the part and are undesirable, especially on aesthetic surfaces.

Part designers can use the results to identify potentially critical sink marks and eliminate them through changes to the part design.



*The Sink Marks Estimate plot shows the effect of design changes on sink mark severity.*

Although cooling circuit layout is a mold design function, the part designer should ensure that the design is not too restrictive to limit the mold designer's ability to provide effective cooling to all sections of the part. Moldflow Part Adviser features a Cooling Quality Analysis, which highlights areas of the part that have inherent cooling problems. This helps to serve two purposes: first it allows part designers to proactively improve the design's cooling characteristics, and second, it alerts mold designers to investigate alternative sources of cooling in the problem areas.

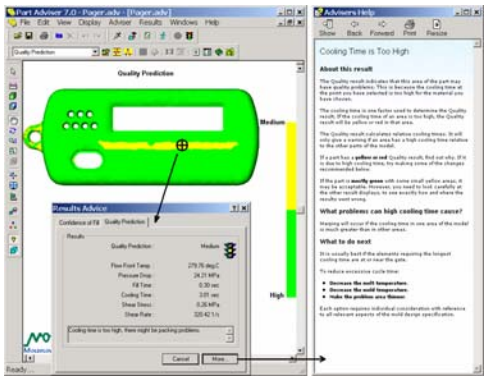


*The Cooling Quality plot identifies areas where heat is concentrated on the part.*

## FIND PRACTICAL ADVICE TO ADDRESS DESIGN ISSUES

What if Moldflow Part Adviser analysis results identify a design issue? The program goes beyond problem identification to provide practical design advice to help users address those issues. The dynamic Results Advice displays the underlying numeric values used to create the plot at each point, and text information about why a problem occurred is instantly available. Then select the *More…* button on the Results Advice window to access online information about how to correct the problem.

For example, when using the Results Advice with the Confidence of Fill plot, values for fill time, pressure, temperature and pressure drop will be updated dynamically based on the position of the mouse. In yellow and red areas that indicate regions of the part where filling could be difficult or impossible, the Results Advice describes the underlying reasons for the problem and suggests design changes that could lead to the part filling completely. This drill-down approach is fundamental to how the MPA software provides practical design advice: the program provides active feedback and does not assume that you know where and how to look for it.

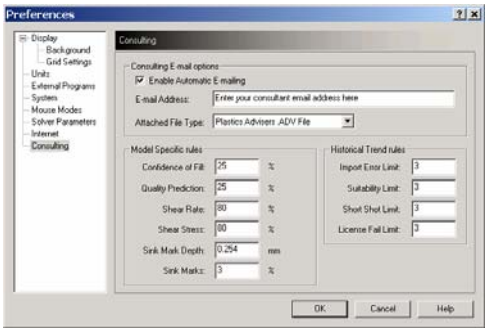


*The dynamic Results Advice suggests design changes to address filling problems.*

MPA 7.0 now features a Connect to Consultants utility that facilitates collaboration and monitoring of Moldflow Part Adviser analysis results by a plastics simulation expert or consultant, usually someone within the user's organization, whom the user specifies. The Connect to Consultants tool allows the expert/consultant to assist the MPA user with result interpretation, problem troubleshooting, alternative design

suggestions, thus improving the MPA user's overall comprehension of the software.

This powerful tool is simple to set up and operate. First, the user specifies the e-mail address of the expert/consultant inside the software. From this point on, the expert/consultant can be notified via e-mail when a specific issue arises. The notification can be triggered either manually or automatically. In manual mode, the MPA user initiates the call to the expert/consultant. When doing this, the user can choose to provide the model and/or a report to facilitate the expert/consultant to quickly comprehend the issue and provide a response. In automatic mode, the expert/consultant can set up criteria that will trigger the automatic notification of a problem. The criteria can be specific to the current model or based on historical trends in results. The latter option allows potential problems to be detected even before they arise.

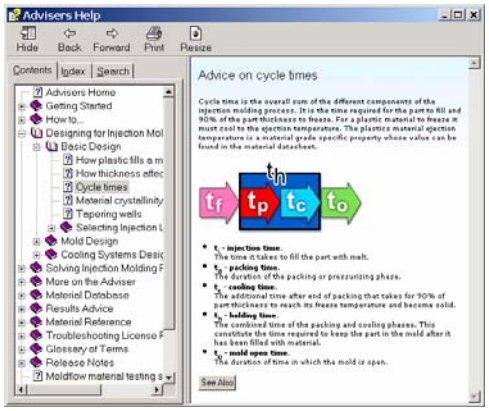



*Connect to Consultant preferences.*

The Connect to Consultants tool fosters a mentoring relationship between the MPA user and the designated expert/consultant in the organization and helps to ensure the successful application of the technology. It can also turn a novice MPA user into a more informed user in the long run.

The online help included with the MPA software provides review information to support design principles, as well as multimedia demonstrations of design concepts and numerous online tutorials, each one created to reinforce the fundamental principles of plastics part design. What this amounts to is a built-in design guide that is always at a designer's fingertips. At each

stage of the design process, designers can consult this Help for specific recommendations that cover topics such as repositioning weld lines, avoiding hesitation, and the relationship between part thickness, polymer flow and cycle time. Every critical design issue is fully defined and explained, and specific, tried-and-true design recommendations are provided for each issue.

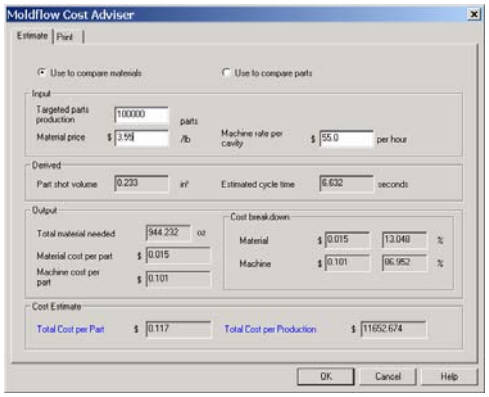



*Comprehensive online Help provides detailed information about the fundamental principles of plastic part design.*

## FACILITATE DESIGN TEAM COMMUNICATION

Designing plastic parts is a collaborative effort. To minimize manufacturing problems and optimize part quality, part designers, mold designers, material suppliers, molders and others should all be involved as early as possible in the design process.

The Cost Adviser tool in Moldflow Part Adviser allows part designers to quickly estimate the production cost associated with a particular part design and to assess the cost impact of a design or material change. The Cost Adviser estimates the preliminary part cost based only on material cost, machine rate and production volume information.




*The Cost Adviser facilitates estimating the impact of design or material change on part cost.*

MPA software automatically generates Internet-ready reports to facilitate communication among all members of the design-through-production team. Using these reports enables team-driven design optimization by allowing timely communication of design concepts from part designers and early review and feedback about manufacturing constraints from other team members.

## ABOUT THE MOLDFLOW PLASTICS ADVISERS PRODUCT LINE

Moldflow Plastics Advisers® (MPA®) solutions bring the benefits of injection molding simulation directly to the desktops of part and mold designers, enabling users to predict and solve injection molding manufacturing problems in the earliest stages of product development. Manufacturing constraints can be considered at the same time as form, fit and function.

### Test Every Part and Mold Concept

MPA products are easy to learn and use and do not require extensive training or plastics expertise. With the power of Moldflow's patented Dual Domain™ technology, users can work directly from 3D solid CAD models without the need to manually create or even view a finite-element mesh, saving hours to days to weeks of model preparation time. Plus, MPA modules are integrated with the world's leading 3D CAD systems, allowing users to work directly from within their familiar CAD environment.

### Get Answers, Communicate Results

Intuitive result displays and detailed design advice help users to quickly optimize part and mold designs. An automatic, Web-based report generator facilitates communication of results among all members of the design-to-manufacturing team. An innovative, e-mail based Connect to Consultants tool facilitates collaboration between a user and a designated plastics simulation expert to assist with results interpretation, problem troubleshooting and identifying design alternatives.

### Entry-level Solution for Part Designers

Moldflow Part Adviser is a plastics flow simulation tool that has been developed with the specific needs of part designers in mind. Users do not need to be dedicated analysts to benefit — even occasional users can quickly assess the manufacturability and quality of plastic part designs for injection molding applications early in the design process.

## Mid-range Solution for Mold Designers

Moldflow Mold Adviser extends simulation capabilities beyond the part cavity to allow mold designers to create and optimize gate and runner systems for single cavity, multi-cavity and family molds. Optional extension modules also allow users to evaluate molded part performance and cooling circuit design. Moldflow Mold Adviser is targeted at the mid-range market to provide the optimal balance of functionality to address critical mold design parameters, before the mold construction begins.

## Link Design to In-depth Analysis

MPA users who need more detailed predictions about all phases of part and mold design, manufacturing and resulting part quality, or who want to investigate alternative manufacturing processes to injection molding, can take advantage of the complete suite of advanced plastics process simulation tools provided by Moldflow Plastics Insight® (MPI®) software. MPI products simulate a broad range of thermoplastic and reactive molding processes and support all design geometry types associated with plastics molding processes. MPA model, material and process data can be exported in a format compatible with MPI software and used as input to perform in-depth MPI analyses..

## Link Design to Manufacturing

MPA software also can export a file that can be input to Moldflow Manufacturing Solutions™ (MMS™) software. MMS software interfaces with the injection molding machine controller and allows users to set up, optimize, monitor and control the injection molding process with a simple, systematic, and documentable method. The MPA output file provides starting points, including shot size, injection velocity and cooling time, for the MMS optimization functions.

For more information about Moldflow Plastics Advisers software and other Moldflow products and services, visit www.moldflow.com.