



Determining Alarms using the Auto Correlator Tool

The purpose of this document is to help you understand the purpose and philosophy behind the Auto Correlator tool.

In this chapter

- ▶ *Part Sampling Tool*
- ▶ *Measurement Editor*
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- ▶ *Alarm Setting Tables*



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Introduction

The Auto Correlator software is a powerful tool to help set meaningful alarms for automated part segregation. By correlating actual part dimensions with the eDART's summary measurements, the Auto Correlator helps you determine which summary measurements actually help predict part quality. While the Auto Correlator will not tell you which alarm levels to choose, it will tell you which summary measurements (e.g. Peak cavity pressure or Cycle Integral) correlate with critical part characteristics (e.g part length, texture, etc).

The Auto Correlator uses data entered from other pieces of Insight System software. First, the user collects data using the Part Sampling tool on the eDART. After the data is loaded into the Analyzer software, the user enters part dimensions using the Measurement Editor. When this is complete, the Auto Correlator can be launched to determine which summary measurements to use for setting alarms.

The following is intended to help you understand the proper usage of the Auto Correlator tool.

Objectives

The objectives for this process are:

- Positively identify sampled parts in the data using the Part Sampling tool.
- Add and permanently store physical measurements in the eDART data files using the Measurement Editor.
- Perform correlation analysis of physical measurements with all summary values using the Auto Correlator tool.

When using this process, you will use three different tools. The following sections in this document explain the tools and processes within these tools in greater detail.

On the eDART™:

1. Parts will be sampled at the press using the Part Sampling tool.

The following are part of RJG's Analyzer software (Windows):

2. Using the Measurement Editor tool, input your measurements in the data column cells, explained later in this manual
3. The Auto Correlator will list correlation coefficients for every summary value originally calculated by the eDART and the measurement entered by the user.

NOTE

The following is a quick list of important points when using Auto Correlator to validate alarms. Please review the "Alarm Settings Methodologies" manual for more detail on alarms:

- 1. Correlation does not equal causality. Sometimes you can get chance correlations on measurements that do not actually predict part quality (e.g. Production Efficiency). Use the Auto Correlator tool in conjunction with the Alarm Setting Tables in Appendix 1 to select alarms which truly make sense.**
- 2. You must make significant changes to the process when taking data using the Part Sampling tool. If you do not make large enough process changes, the correlations will be based more on measurement error than on true part measurements.**
- 3. If you don't vary viscosity in your test, ignore stroke/hydraulic correlations.**

NOTE

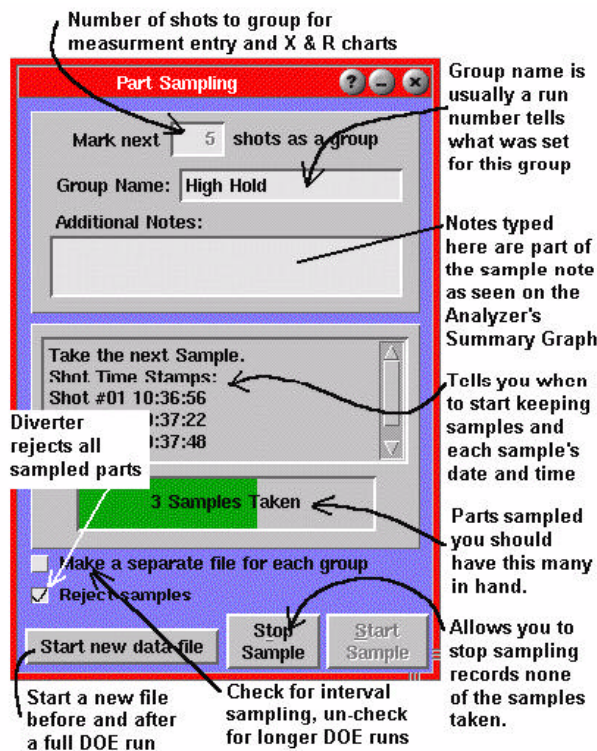
You may not always find a reliable correlation.



Part Sampling Tool

Use this tool to accurately identify and mark sampled parts in the data files for later correlation to physical measurements of the parts. The tool places notes in the data files that tell the *Measurement Editor* tool in the *Analyzer* to make a space for inserting measurements. It is better to make five or more sets of data to get accurate correlations.

This tool is most easily launched by selecting “Part Sampling” from the “Summary Graph” menu bar.



Mark Next # Shots

This is the number of shots that will be collected as part of the current group. Generally, once you start the sampling (*Start* button), you collect and measure the next # of parts and enter their part measurements into the data later.

Group Name

This becomes part of the note describing the parts. When you bring up the Measurement Editor tool in RJG’s Windows-based Analyzer program, each group will have the name you enter here as a tag. This helps you keep groups separate (e.g. “Run 1”, “Run 2” or “Hold P=3000”, “Hold P=4000” etc.). Refer to the *Analyzer* section in the *eDART System™* User Guide for more information.



(Part Sampling Tool continued)

Additional Notes

Here you can add additional information to the sample. This extra information is visible in the Analyzer Summary Graph as extra text on the notes. These samples are actually saved as notes and picked up (because of special formatting) by the Measurement Editor tool in the Analyzer.

Parts Sampling List

This window informs you of what the Part Sampling tool is doing after you click the *Start* button. It lets you know just when to actually grab the parts and the date/time stamp for each one.

Status Box

Shows the number of parts sampled with a green color bar indicating how long (percentage-wise) until the end.

Make a separate file for each group

If this box is checked, the data file will “break” and start a new file each time the sampler completes a group. You should use this method if you have remote users editing the part measurements using a windows computer. This is because you must NOT edit part measurements in a file while data storage in progress.

Normally this switch is off if you want to save several groups in a single file for a designed experiment. Then the summary, notes and measurements can all be transported easily in small files.

If you sample on a regular interval (say hourly +/- a random window) then this box should be checked. Then each file for the sampling will be small and can be uploaded or edited with parts measurements immediately. Also, the FTP file up-load can be set up to limit copying of cycle data (the large stuff) to only those files with notes on them.

Start new data file

If you are running a designed experiment you will normally turn off the “Make a separate file...” switch. Then just before you start the run, press the “Start new data file” button. This will end the current data file which may have setup and stabilization data in it that is not pertinent to the experiment. Then after the experiment is finished press the “Start new data file” button again. This will end the file with the experimental data in it so that the whole experiment is contained in that one file.

When you press this button, a message pops up saying which file is about to be completed at the end of the current cycle.



(Part Sampling Tool continued)

Reject Samples

When checked, the Part Diverter Control is told to reject every cycle during the part sampling. This is useful in your use of a part diverter or part sampling robot. The parts are counted as rejects since that is the bin to which they go. If you are using *InsightPro's* Scrap Entry (on the *eDART* or Windows) you can later restore them after they have been measured.

The Part Sampling tool operates a “Sorting Output”, “Sample Parts” signal to an OR2-D relay if you have one defined in Sensor Locations. This signal stays on during the entire cycle for which the parts are sampled. You might use it to tell a robot to place the parts in a special sample location for measurement.

Stop Sample

Lets you stop sampling in mid-group. You might want to do this if something goes wrong and you don't want the note added to the data. The note (which tags the data for later part measurement entry) is not actually added until the total number of samples finishes normally.

Start Sample

Starts part sampling. The note containing the number, group name, and notes is not inserted into the data until the end of the sample. When finished, the note gets inserted on the first sample in the group.



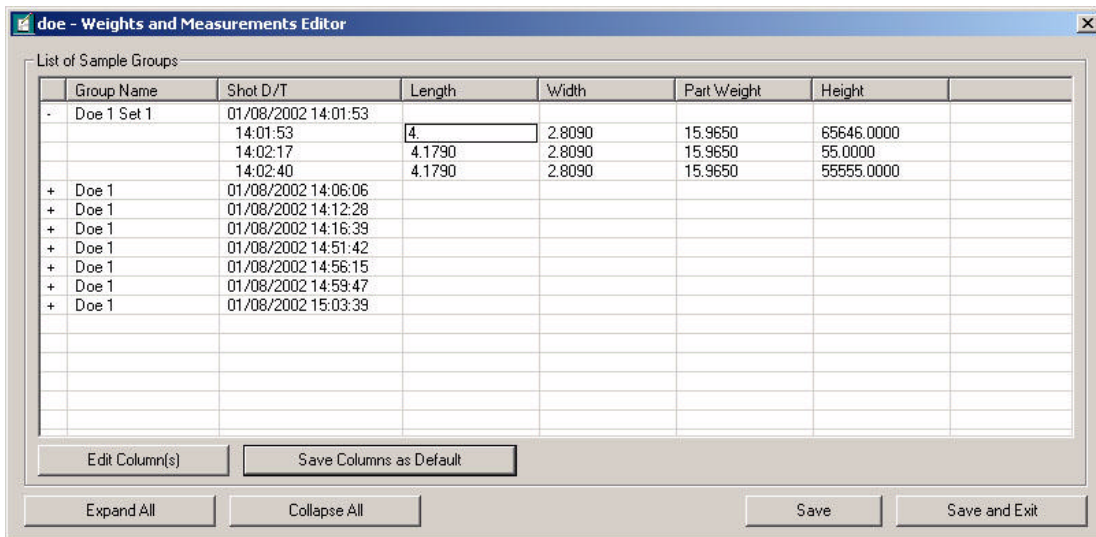
Measurement Editor

The Measurement Editor is a useful tool because it can record physical measurements that the *eDART™* can't do. You can take these measurements and input them into the Auto Correlator tool.

It is important that the Part Sampling Tool be used to identify parts to be measured. This creates the Group Name.

Here is an example of the Analyzer's Measurement Editor tool showing the Group Name "Doe 1 Set 1" expanded to show all the samples in the group so that length could be added for each one.

From the Analyzer tool, click the Measurement Editor icon. The following window will appear:



Using the Measurement Editor, you will add columns for each measurement you wish to enter, enter measurements for each part, then save and exit.

Group Name

This is designated in the Part Sampling Tool on the *eDART™*. Use this field to identify sample groups.

Once the data columns and rows are displayed, click on the + sign in the column next to a Group Name to expand the sample group. You can click on individual cells and type in the relevant data, like the example above.

Shot D/T Stamp

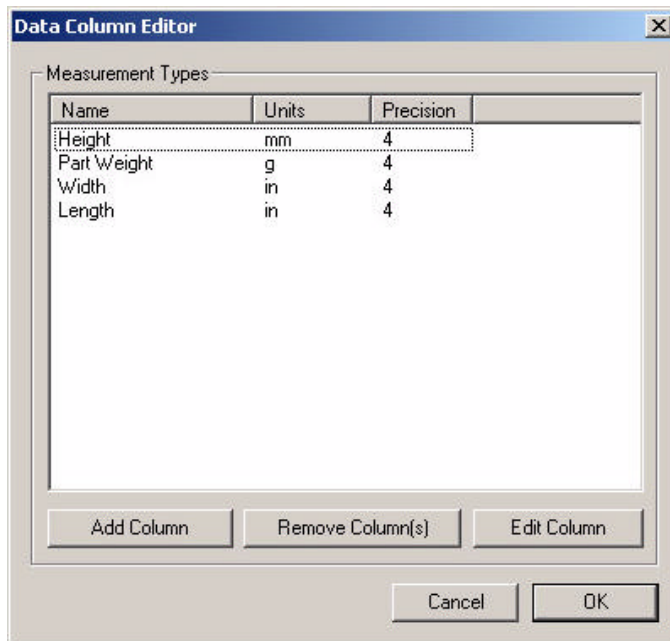
Displays the date and time of when the sample group was taken, as well as individual samples.



(Measurement Editor continued)

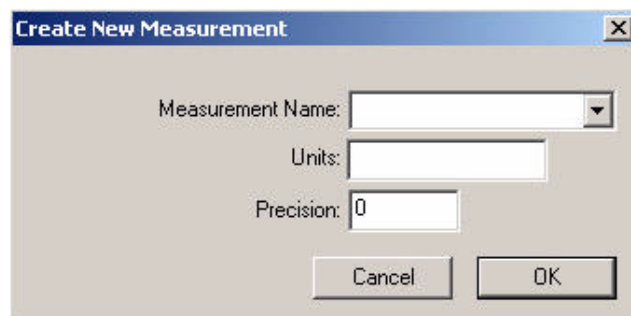
Edit Column(s)

Click Edit Column(s) to add a column, remove a column, or edit a column in the sample groups list. The Data Column Editor window will display.



Add Column

Click Add Column to add a column to the list of sample groups. The Create New Measurement window will display. Choose a measurement name from the list or type your own measurement name. You can add any type of measurement you want. Type in a unit of measure (mm, cm, etc.) for this new measurement and a precision value. The precision value is how many digits will be displayed on the screen.





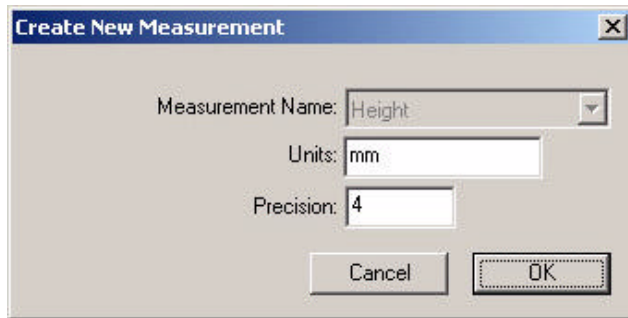
(Measurement Editor continued)

Remove Column(s)

Highlight a column in the Data Column Editor window and click Remove Column to remove this column from the list.

Edit Columns

Highlight a column in the Data Column Editor window and click Edit Column to change a column's units and precision length. The Create New Measurement window will display.



Expand All/Collapse All

Click Expand All to expand all the sample groups in the list, or Collapse All to collapse all groups.

Save

Click Save to save any changes or data additions to the summary.ph2 file.

Save and Exit

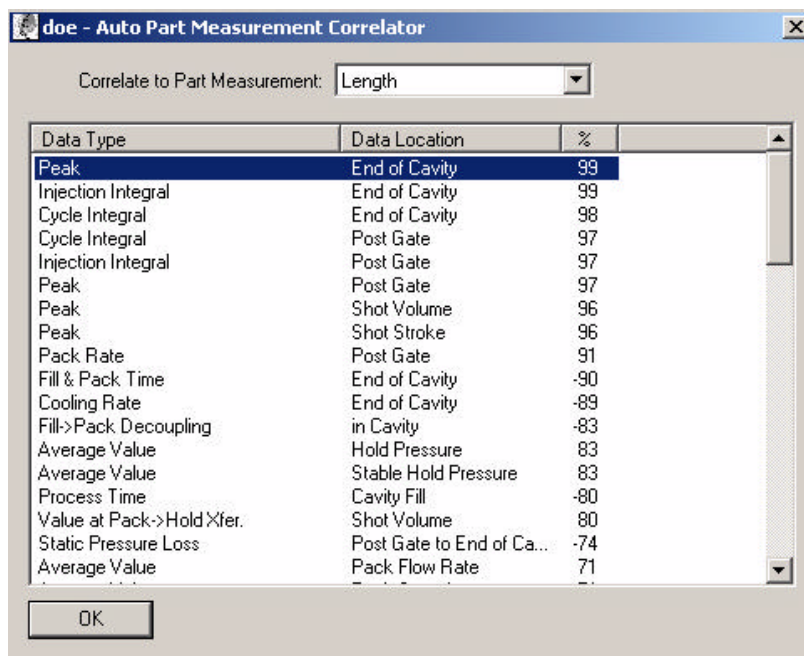
Click Save and Exit to save any changes or data additions and exit the Measurement Editor.



Auto Correlator Tool

The Auto Correlator is a display tool that will help you determine if the measurements you sampled correlate to the measurements the *eDART™* makes every cycle. Before launching the Auto Correlator, be sure you have sampled data using the Part Sampling tool and entered the part measurements into the Measurement Editor.

From the Analyzer tool, select the mold name you wish to analyze, then click the Auto Correlator icon. The following window will appear:



When you select a part measurement from the “Correlate to Part Measurement” drop-down field, the correlation table will automatically fill in.

Correlate to Part Measurement

Click this drop-down arrow to list all available part measurements. Select a measurement to correlate this part to.

Data Type

This column is the type of summary variables in the stored data. Peak, Cycle Integral, etc.



(Auto Correlator continued)

Data Location

This column is the location of the summary variable types. For example, you may have two peaks, one a post gate and one an end of cavity.

Percent

This column lists the correlation coefficient. The closer to 100% the data type is, the better. A negative percentage is not any worse than a positive percent. This only differentiates between a negative or positive correlation.



Appendix 1: Alarm Setting Tables

Summary Values for Setting Alarms

Once you have determined the quality issues you want to detect, use the following tables to help in choosing summary measurements for your alarms. Each table contains measurements to use for Strategy A (Cavity Pressure) and Strategy B (Hydraulic and Stroke), Strategy A generally being preferable. These summary values are ranked in order of preference in each table. The ones at the top of the list are usually the best at predicting part quality. Each value is listed in “Type, Location” format.

For Multi-cavity instrumentation, you can also:

- Peak Cavity Pressure with Average Value, Peak Cavity Pressure
- Process Time, Cavity Fill with Average Value, Cavity Fill Time
- Process Time, Cavity Pack with Average Value, Cavity Pack Time

Detecting Short Shots

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Peak, End-of-Cavity (Low Alarm) - Post Gate or Mid Cavity is acceptable	Peak, Shot Volume (+/- six sigma)
Cycle Integral, End-of-Cavity (Low Alarm) - also picks up cooling - Post Gate or Mid Cavity is acceptable	Cycle Integral, Shot Volume (+/- six sigma)
Process Time, Fill and Pack Time (High Alarm) - if you don't have End-of-Cavity (especially for thin-wall)	Effective Viscosity, Fill (High Alarm)

Detecting Sinks

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Peak, End-of-Cavity (Low Alarm)	Peak, Shot Volume (+/- six sigma)
Cycle Integral, End-of-Cavity (Low Alarm) - also picks up cooling, will not pick up gate discharge	Cycle Integral, Shot Volume (+/- six sigma)
Cycle Integral, Post Gate (Low Alarm) - also picks up cooling, gate discharge, etc.	Effective Viscosity, Fill (High Alarm)
Process Time, Fill and Pack Time (High Alarm) - if you don't have End-of-Cavity	



Detecting Flash

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Peak - any cavity sensor (High Alarm)	Peak, Shot Volume (+/- six sigma)
Process Time, Fill and Pack Time (Low Alarm)	Cycle Integral, Shot Volume (+/- six sigma)
	Effective Viscosity, Fill (Low Alarm)

Detecting Texture

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Process Time, Fill and Pack Time	Value at Fill -> Pack Transfer, Volume
Process Time, Pack Rate	Value at Pack -> Hold Transfer, Volume
Process Time, Cavity Fill - any or all cavity sensors	Effective Viscosity, Fill
Peak - any cavity sensor	Peak, Shot Volume (+/- six sigma)
	Cycle Integral, Shot Volume (+/- six sigma)

Detecting Dimensions

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Cycle Integral, End-of-Cavity	Peak, Shot Volume (+/- six sigma)
Cycle Integral, Post Gate	Cycle Integral, Shot Volume (+/- six sigma)
Peak, cavity pressure	Effective Viscosity, Fill
Injection Integral, cavity pressure (if lots of mold deflection) <i>Should be used w/ Sequence Time, Injection Forward alarm</i>	Peak, Hydraulic Injection
	Value at Pack -> Hold Transfer, Injection Pressure
	Value at Fill -> Pack Transfer, Injection Pressure or Shot Volume

Detecting Check Ring Leakage

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Process Time, Cavity Fill	Peak, Shot Volume
Process Time, Fill and Pack Time	Cycle Integral, Shot Volume



Detecting Thin Wall Part Characteristics (other than texture)

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Fill and Pack Integral, End-of-Cavity	Peak, Shot Volume (+/- six sigma)
Fill and Pack Integral, other cavity pressure	Effective Viscosity, Fill
Peak, End-of-Cavity (other cavity sensors acceptable)	Fill and Pack Integral, Shot Volume (+/- six sigma)
Process Time, Fill and Pack Time	Value at Pack -> Hold Transfer, Injection Pressure or Shot Volume
	Value at Fill -> Pack Transfer, Injection Pressure or Shot Volume

Detecting Stresses and Molecular Orientation

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Process Time, Fill and Pack Time	Sequence Time, Fill Time
Process Time, Cavity Fill	Value at Pack -> Hold Transfer, Shot Volume
Fill Shear Rate, At Transfer	
Static or Dynamic Pressure Loss, Post Gate to End-of-Cavity	
Static or Dynamic Pressure Loss, Injection to Post Gate	

Detecting Blocked Cavities

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Range, Post Gate Peak	Peak, Shot Volume (+/- six sigma)
Range, End of Cavity Peak	Cycle Integral, Shot Volume
Process Time, Cavity Fill	

Detecting Mold Balance

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Balance, Cavity Fill Time	N/A
Balance, Cavity Pack Time	
Balance, End of Cavity Peak	
Balance, other cavity peak	



Detecting Crystallinity

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Cooling Rate, any cavity sensor (in conjunction with Gate Seal alarm)	Average Value, Mold Surface Temp. (thermocouple)
Cycle Integral, any cavity sensor	

Detecting Core Deflection

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Peak, Core Deflection	Effective Viscosity, Fill
Cycle Integral, Core Deflection	Sequence Time, Fill Time

Detecting Warp

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Cooling Rate, any cavity sensor	Sequence Time, Fill Time
Gate Seal, Post Gate	Sequence Time, Pack Time
Static or Dynamic Pressure Loss, Post Gate to End-of-Cavity	Sequence Time, Injection Forward
Process Time, Fill and Pack Time	
Process Time, Cavity Fill	

Detecting Mixing Consistency

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
	Average Value, Back Pressure
	Sequence Time, Screw Run

Detecting Viscosity Changes

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Static or Dynamic Pressure Loss, Post Gate to End-of-Cavity	Effective Viscosity, Fill
Static or Dynamic Pressure Loss, Injection to Post Gate	Sequence Time, Screw Run
Value at Fill -> Pack Transfer, Post Gate	



Detecting Gate Seal

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Gate Seal, Post Gate	Sequence Time, Injection Forward

Detecting Machine Operation Consistency

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
	Sequence Time, Fill Time
	Sequence Time, Cycle Time

Detecting Setup Consistency

Cavity Pressure (Strategy A)	Hydraulic and Stroke (Strategy B)
Cycle Integral, any cavity sensor	Sequence Time, Fill Time
Process Metric, Match Error	Sequence Time, Injection Forward
	Sequence Time, Cycle Time
	Sequence Time, Screw Run
	Value at Fill -> Pack Transfer, Volume
	Average Value, Hold Pressure
	Average Value, Back Pressure
	Average Value, Fill Flow Rate
	Average Value, Pack Flow Rate
	Decompression, Shot Volume