Understanding Scientific Process Documentation





Created exclusively for **Nexeo Plastics** by Routsis Training, this free guide contains excerpts from Routsis's *Scientific Molding Courses*.

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PROCESS DOCUMENTATION

There are several different appoaches to process documentation: Machine Dependent, Machine Independent, and Hybrid Documentation.

In practice, process documentation needs to be collected for both the machine and the process.

Machine Dependent Process Documentation

Machine-specific clamp and ejection settings are needed and may be saved into the machine's computer system.

Machine-dependent parameters are based on process inputs and are specific to each molding machine. These parameters will not transfer directly from one machine to another even if the machine specifications are identical.

Examples of machine-dependent parameters include:

- Barrel Temperature
- Injection Velocity
- Transfer Velocity
- Transfer Position
- Clamp Tonnage





The main advantage of using machine-dependent documentation is that it provides data which can be directly entered into the molding machine — typically allowing the setup technician to get the process up and running more quickly; and to spend less time documenting the process.

	epena	ent	Machine #	14		
rocess Se	tup Sl	heet	Mold #	640		
	-		# of Cavities	4		
arrel & Recovery			Material Type	PC		
		7.0	Material Grade	L5456		
one 1	300		Technician	J. MOLDE	J. MOLDER	
one 2	305		Date	2/3/202)	
ine 3	310	°C				
ne 4	315	°C				
0110 4	_	-				
ozzle	320	°C				
ozzle crew Speed ¹ Stage Injection	\$20 ¥5	°C RPM	Mold Clamping Clamping Force	216	tons	
lozzle crew Speed ^{at} Stage Injection	\$20 ¥5	°C RPM	Mold Clamping	210	tons	
ozzle rew Speed Stage Injection not Size	\$20 \\Y5 \\250] °C] RPM] mm	Mold Clamping Clamping Force Cycle Time	210	tons	
orew Speed Stage Injection not Size clocity 1	250 75 250 100	°C RPM mm mm/s	Mold Clamping Clamping Force Cycle Time Clamp Type	210 13.02 TOGGLE	tons s	
lozzle icrew Speed st Stage Injection ihot Size felocity 1 Position 1	250 75 250 100 200	°C RPM mm mm/s mm	Mold Clamping Clamping Force Cycle Time Clamp Type	210 13.02 TOGGLE	tons s	
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lozzle icrew Speed * Stage Injection that Size lelocity 1 vosition 1 lelocity 2 vosition 2	220 45 250 200 200 100 150	°C RPM mm mm/s mm mm/s mm/s mm	Mold Clamping Clamping Force Cycle Time Clamp Type Part Cooling Cooling Time	210 13.02 TOGGLE] tons s] s	
lozzle icrew Speed * Stage Injection that Size felocity 1 osition 1 felocity 2 fosition 2 felocity 3	250 45 250 100 200 100 150 100	°C RPM mm mm/s mm mm/s mm mm/s	Mold Clamping Clamping Force Cycle Time Clamp Type Part Cooling Cooling Time Core Setpoint	210 13.02 7060LE 6 80] tons s] s °C	
ozzle crew Speed Stage Injection hot Size slocity 1 sition 1 sition 2 slocity 3 ansfer	320 45 250 100 200 100 100 100 100 50	°C RPM mm mm/s mm mm/s mm mm/s mm	Mold Clamping Clamping Force Cycle Time Clamp Type Part Cooling Cooling Time Core Setpoint Cavity Setpoint	210 13.02 7060LE 6 80 80	s s °C °C	

Disadvantages

The disadvantages of using machine-dependent documentation during mold setup are that the process inputs are replicated from a past run on a particular machine. These parameters cannot be used on a different molding machine – not even on machines with identical specifications.

Machine-dependent documentation does not provide process output data, makes process troubleshooting very difficult, and does not compensate for changes in lot-to-lot material variation.



Machine Independent Process Documentation

Machine-independent parameters are based on process outputs from a good molding process. Many machine-independent parameters are identical to the process inputs, such as Packing Time and Clamp Tonnage.

All machine-independent parameters facilitate a process to be easily transferred from one molding machine to another. Using such parameters is ideal for companies who run a mold in multiple machines.

14

640

4

PC

L5456

J. MOLDER

2/3/2021

210

13.02

TOGGLE

6

28

80

9.5

80

82

9.5

tons

S

s

°C

°C

°C

°C

I/min

I/min

Examples of machine-independent parameters include:

- Melt Temperature
- 1st Stage Fill Time
- 1st Stage Fill-only Part Weight
- 2nd Stage Pressure Applied to the Plastic
- 2nd Stage Packing Time
- Final Part Weight



Advantages

Using machine-independent documentation during mold setup provides significant advantages: The data provided is based on process outputs — allowing the process to be transferred to different molding machines.

Process troubleshooting is also simplified by clearly identifying the resultant process. In addition, the process is developed independent of variations in the plastic material.

Disadvantages

The disadvantages of using machine-independent documentation during mold setup are that more processing knowledge is required, more effort is required to implement, and more time is needed to properly document.



Hybrid Process Documentation

Some molders use a hybrid form of process documentation that combines both machine-dependent and machine-independent parameters. The machine-dependent documentation is used for reference during setup, while the machine-independent documentation is used once the machine is started.

The hybrid approach can be confusing — as machine inputs will provide different outputs each time they are used. For example, a 300°C degree Barrel Temperature may result in a 305°C Melt Temperature in one instance and 285°C in another.

Be sure to clarify which parameters are more important. For instance, both the Barrel Temperatures and the Melt Temperature may be provided. In this case, the machine independent Melt Temperature should be highlighted to identify that it is more important.

By identifying the more important parameter, the die setter will know that the Barrel Temperatures should be adjusted in order to achieve the desired Melt Temperature. This also applies to the 1st Stage Fill Time and Injection Velocity parameters.

Hybrid Process			Machine #	14	
Setup Shee	t		Mold #	640	
			# of Cavities	4	
Barrel & Recovery			Material Type	PC	
		1	Material Grade	L5456	
Zone 1	300	°C	Technician	J. MOLDE	R
Zone 2	305	°C	Date	2/3/2021	
Zone 3	310	°C			
Zone 4	315	°C			
Nozzle	320	°C			
Melt Temp	305	°C	Mold Clamping		
Screw Speed	45	RPM	inera eramping		
Recovery Time	4.76	s	Clamping Force	210	tons
Back Pressure	25	bar	Cycle Time	13.02	s
Chot Cize	254]	Part Cooling		
Shot Size	250	mm	Part Cooling		
Shot Size Velocity 1	250	mm mm/s	Part Cooling Cooling Time	6] s
Shot Size Velocity 1 Position 1	250 100 200	mm mm/s mm	Part Cooling Cooling Time Core Setpoint	6 80]s ∣°C
Shot Size Velocity 1 Position 1 Velocity 2	250 100 200 100	mm mm/s mm mm/s	Part Cooling Cooling Time Core Setpoint Core Coolant IN	4 03 34	s °C °C
Shot Size Velocity 1 Position 1 Velocity 2 Position 2	250 100 200 100 150	mm mm/s mm mm/s mm	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT	6 03 35 03	s °C °C °C
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3	250 100 200 100 150 100	mm mm/s mm mm/s mm	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow	6 80 78 80 9.5	s °C °C V/mi
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer	250 100 200 100 150 100 50	mm mm/s mm mm/s mm mm/s mm	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint	4 80 98 80 9.5 80	s °C °C I/mi °C
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure	250 100 200 100 150 100 50 1000	mm mm/s mm mm/s mm mm/s mm bar	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Coolant IN	4 80 78 80 9.5 80 80	s °C °C V/mi °C °C
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time	250 100 200 100 150 100 50 1000 2.05	mm mm/s mm mm/s mm mm/s mm bar s	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Coolant IN Cavity Coolant OUT	2 53 95 53 53 53 53 53 53 53	s °C °C V/mi °C °C
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time 1st Stage Weight	250 100 200 100 150 100 50 50 1000 2.05 110.7	mm mm/s mm mm/s mm mm/s mm bar s grams	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Coolant IN Cavity Coolant OUT Cavity Flow	6 80 98 80 9.5 80 80 80 82 9.5	s °C °C °C V/mi °C °C °C V/mi
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time 1st Stage Weight Transfer Pressure	250 100 200 100 150 150 100 50 1000 2,05 100,7 100,7 2,42	mm mm/s mm mm/s mm bar s grams bar	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Coolant IN Cavity Coolant OUT Cavity Flow	6 80 78 80 95 80 80 82 9,5	s °C °C I/mi °C °C °C I/mi
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time 1st Stage Weight Transfer Pressure 2nd Stage Packing	250 100 200 100 150 100 50 1000 2.05 110.7 642	mm mm/s mm mm/s mm bar s grams bar	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Setpoint Cavity Coolant OUT Cavity Flow	4 96 97 95 95 95 96 96 92 9,5	s °C °C °C V/mi °C °C °C I/mi
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time 1st Stage Weight Transfer Pressure 2 nd Stage Packing Packing Pressure	250 100 200 100 150 150 50 1000 2.05 1007 642 442	mm mm/s mm mm/s mm bar s grams bar bar bar	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Setpoint Cavity Coolant IN Cavity Coolant OUT Cavity Flow	4 80 78 80 9.5 80 80 82 9.5	s c c c c c c c c c c c c c c c c c c c
Shot Size Velocity 1 Position 1 Velocity 2 Position 2 Velocity 3 Transfer Maximum Pressure Fill Time 1st Stage Weight Transfer Pressure 2nd Stage Packing Packing Pressure Packing Time	250 100 200 100 150 100 50 1000 2.05 1000 2.05 100.7 642 700 2.00	mm mm/s mm mm/s mm bar s grams bar bar s bar	Part Cooling Cooling Time Core Setpoint Core Coolant IN Core Coolant OUT Core Flow Cavity Setpoint Cavity Setpoint Cavity Coolant IN Cavity Flow	4 99 97 97 90 90 98 97 97 97 97 97 97	s c c c c c c c c c c c c c c c c c c c



Advantages

There are several advantages to using a hybrid form of process documentation. Doing so provides specific data to enter into the machine, given that the process has been run previously on that particular machine — and machine-independent data, which is helpful if the mold has not been run on that particular machine.

The hybrid approach also provides the molder with all the information necessary to properly troubleshoot the process.

Disadvantages

A clear disadvantage of using a hybrid form of process documentation is that it takes more time to document both sets of parameters. Furthermore, it can become quite confusing if the intent and proper use of this information is not well understood by all the technicians.



