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IntelliMold Systems
OEM Integration:
ENGEL

Revision Level: Release
Document Number: 7.5.1.0.30.004.001

The following information is for reference only. It is subject to change and may not be identical on all types of Engel.

The following information has been gathered to help in start-up, set-up and troubleshooting any problems that have to do with the successful operation of the IntelliMold System on a Engel Injection Molding Machine.

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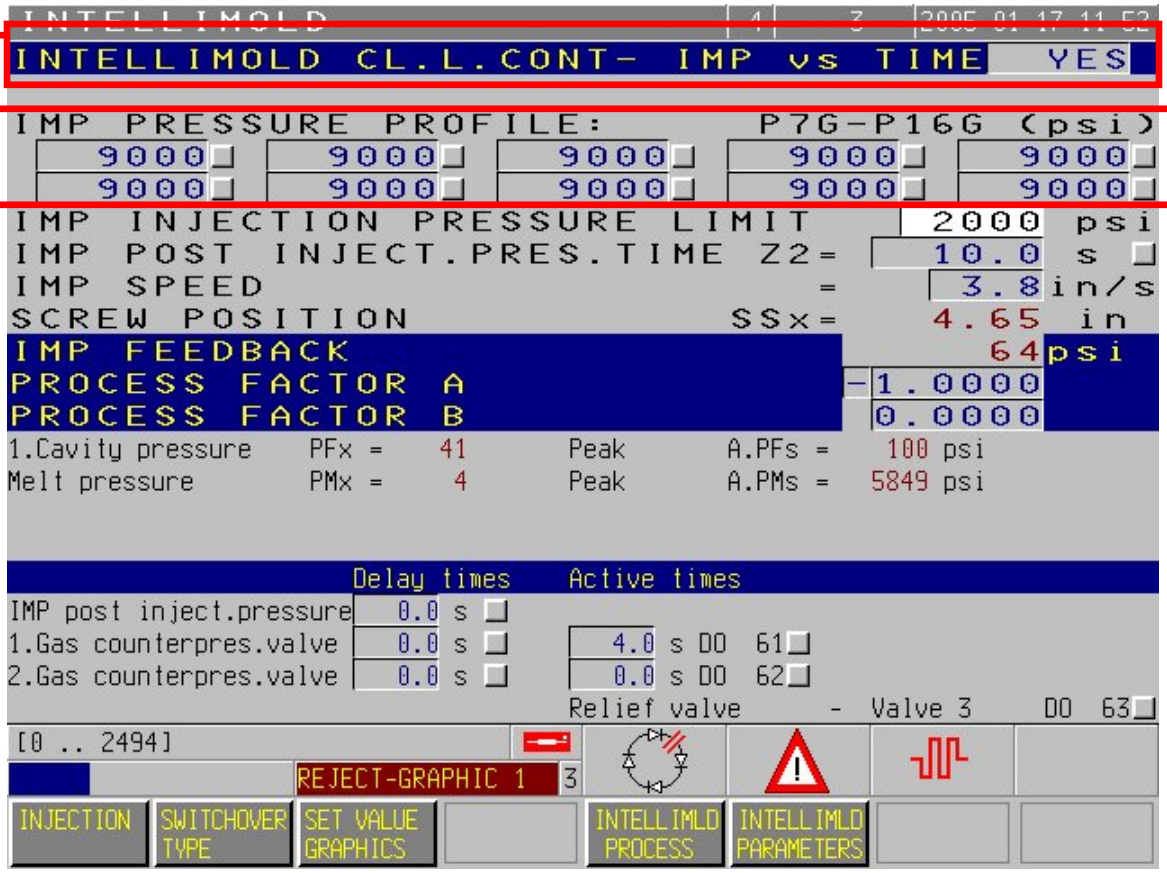
What is IntelliMold™?

IntelliMold™ is a unique process control method that provides measurements and control of pressure transition throughout the cavity in real time. This is achieved by generating a new process parameter called internal melt pressure, IMP. IMP is generated from real-time measurements, every 2 milliseconds, from a transducer in the nozzle extension and at the last place to fill in the cavity. The real-time value of the IMP is compared with the operator-entered set point and the hydraulics are manipulated in a manner to bring the actual value to the set point. The IMP replaces the need for boost, pack and hold profiles.

In addition to the 2 pressure transducers, the cavity is also charged with 200 psi of air prior to the start of injection. We provide an air amplifier that will boost normal plant air between 50-150 psi to the specified 200 psi. The primary purpose for this is to give the transducers a known start point prior to the start of injection. An additional advantage of this pressure within the cavity is that it helps make the material more dense as it fills the cavity. Using this in conjunction with the material based control of injection provides parts with a more even density throughout the part. With this method and process control, each section of an injection molded part solidifies in an equal, pressure-balanced and stress free environment.

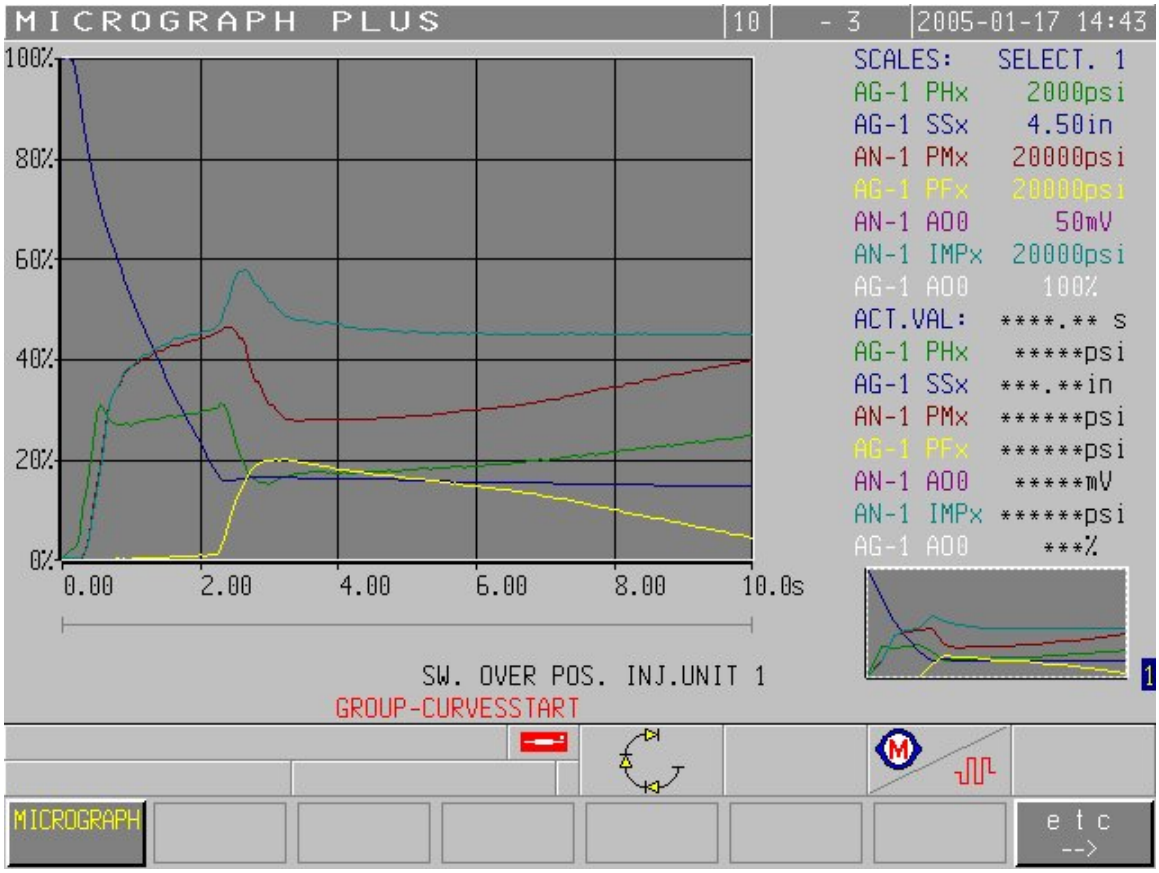
"You can't control that which you can't measure; yet, that is what we, the molders, have been trying to do for many years."
- Milko Guergov

The following screen is the main IntelliMold™ Screen. This screen contains the majority of processing set points. This screen also contains the actual and peak values used for process feedback.



CONTROL / IntelliMold™ Enable: It is from here you turn the system on or off. When the system is enabled (YES), all of the IntelliMold™ set points become active using IMP (*Internal Melt Pressure*) as the control variable. When the system is disabled the machine will ignore all IntelliMold set points and operate in a conventional manner.

This screen gives the ability to set up to ten segments of IMP / Time. Although one segment is the preferred method of processing with Intellimold, under certain circumstances, IMP profiling may be required. The IMP set point is based on actual melt pressure measurements, and directly uses suggested molding parameters from the material supplier. See table and graphs below.



(Fast Injection Speed: resulting profile from previous screen)

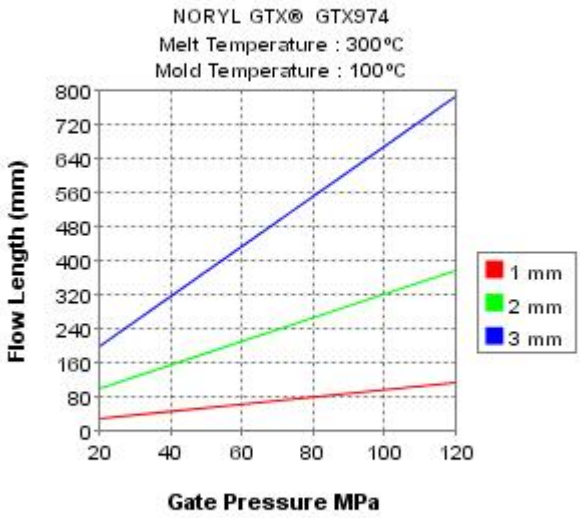
Processing

Parameter		
Injection Molding	Value	Unit
Drying Temperature	100 - 120	°C
Drying Time	2 - 3	hrs
Maximum Moisture Content	0.02	%
Melt Temperature	290 - 320	°C
Nozzle Temperature	280 - 310	°C
Front - Zone 3 Temperature	290 - 320	°C
Middle - Zone 2 Temperature	280 - 300	°C
Rear - Zone 1 Temperature	260 - 280	°C
Hopper Temperature	60 - 80	°C
Mold Temperature	80 - 120	°C

Source GMD, last updated:03/23/2004

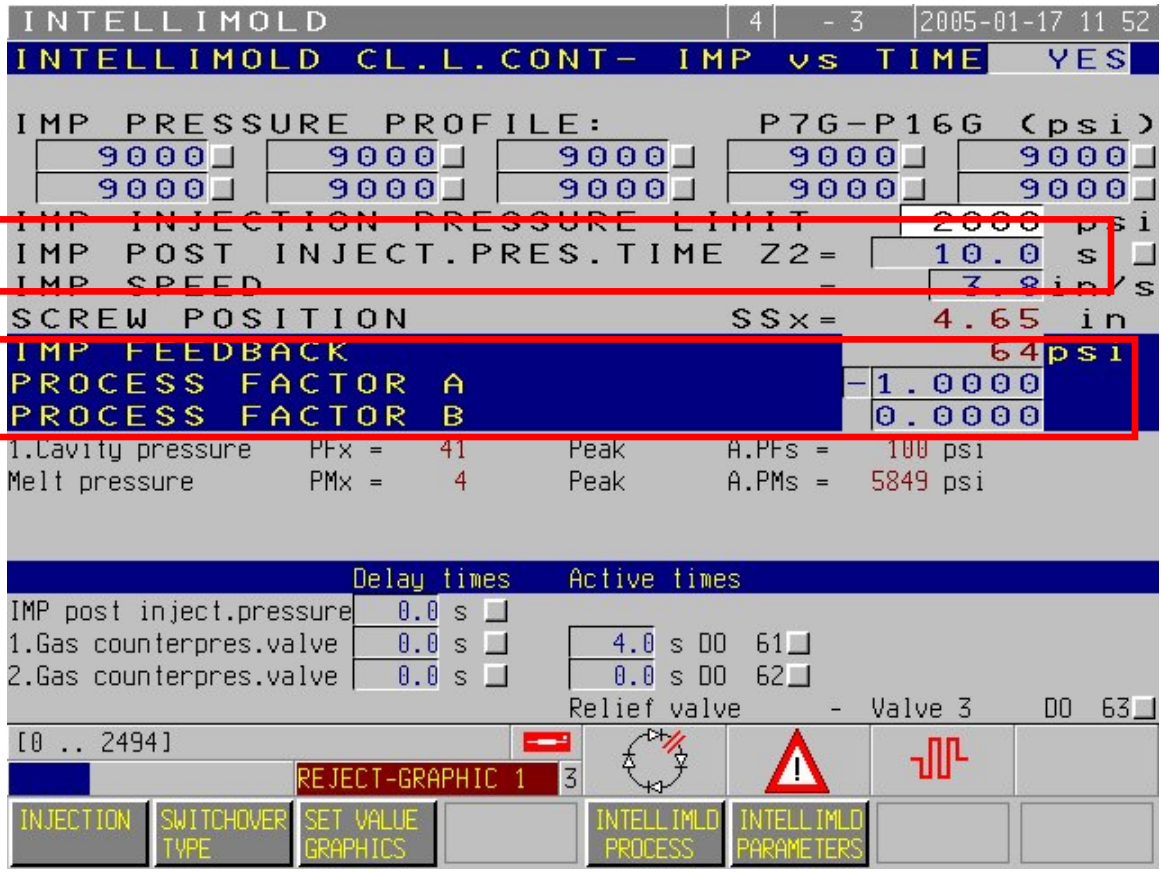
CALCULATED FLOW LENGTH INDICATION

Moldflow® Radial Flow Analysis



Note: Technical support is recommended if Gate Pressure is greater than 80 MPa. Contact your local representative.

The above table and graph shows an example of material processing recommendations from a material supplier.

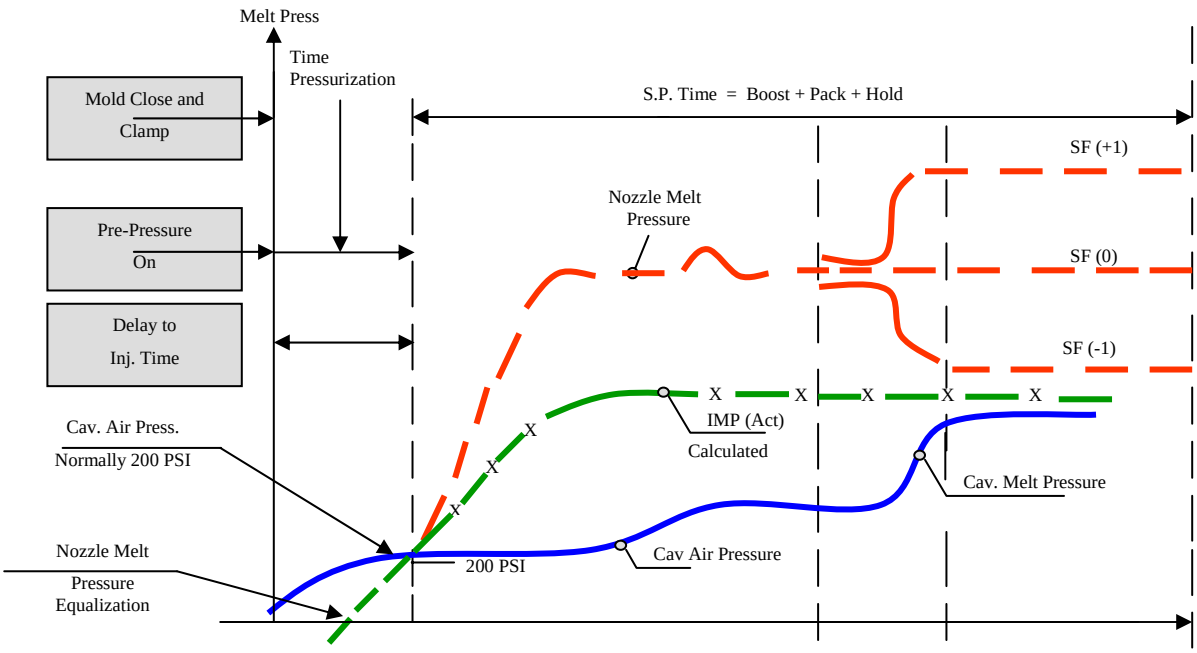


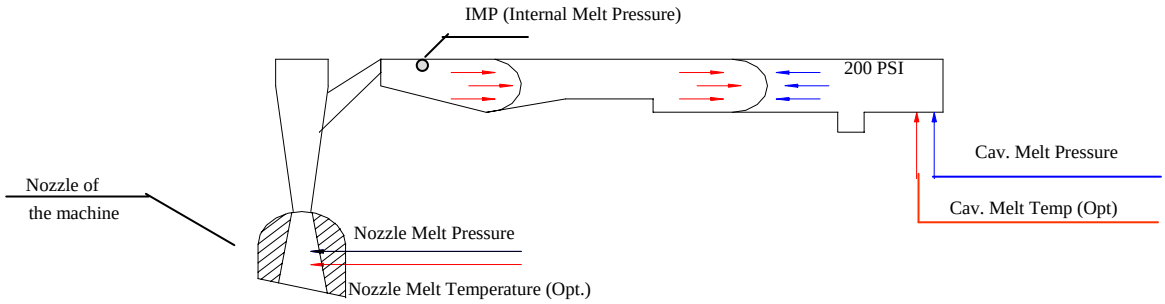
IntelliMold Injection Time, used to specify the amount of time used during injection.

Process Factor A and **B** are user entered setpoints of the IntelliMold™ System. **Process Factor A** (PFA) is a setpoint that affects how the nozzle pressure reacts to the introduction of cavity pressure with a range of –1.00 to +1.00. **Process Factor B** (PFB) has been installed in the software to incorporate future enhancement. PFB should remain zero.)

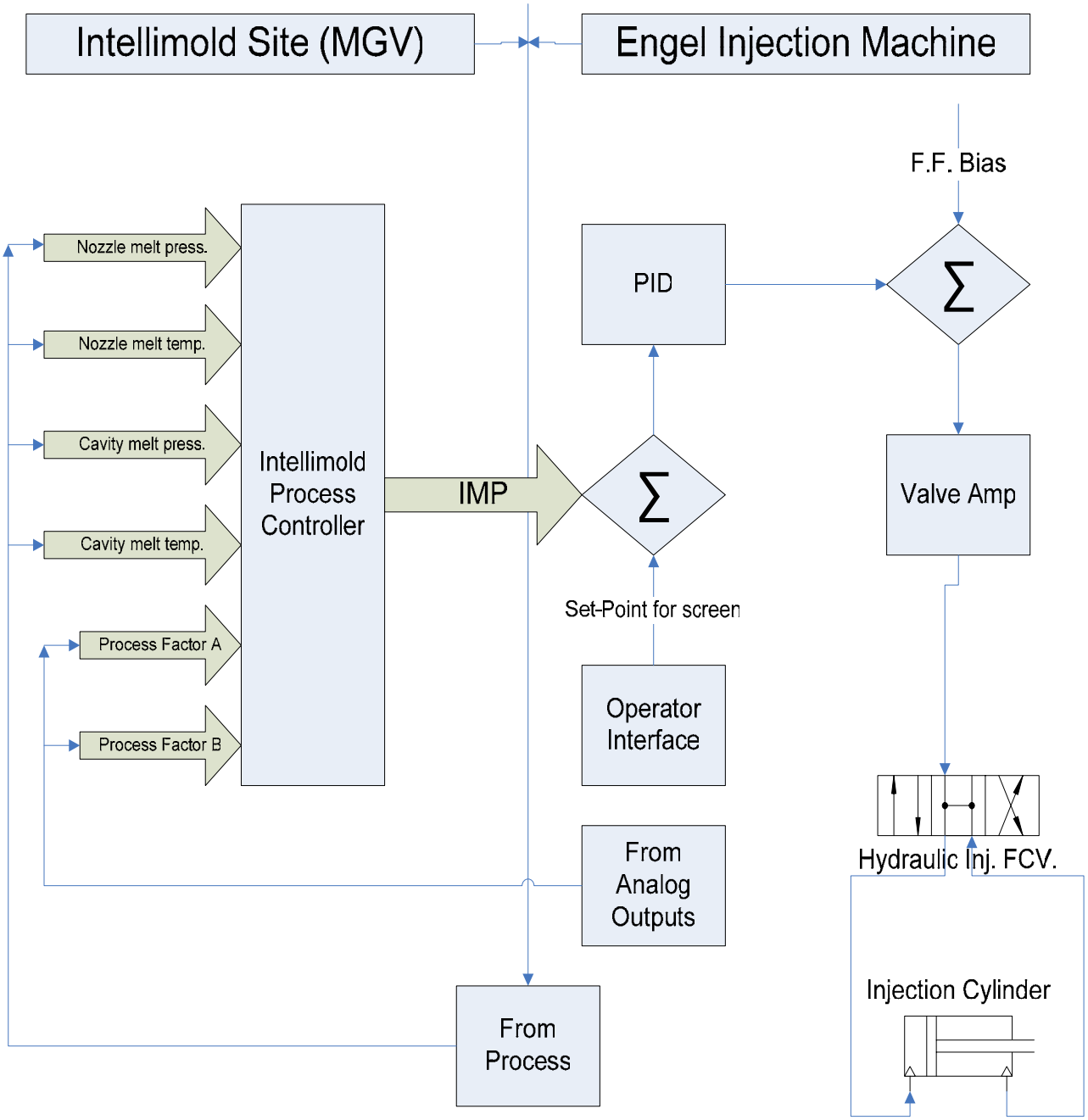
Process Factor A:B

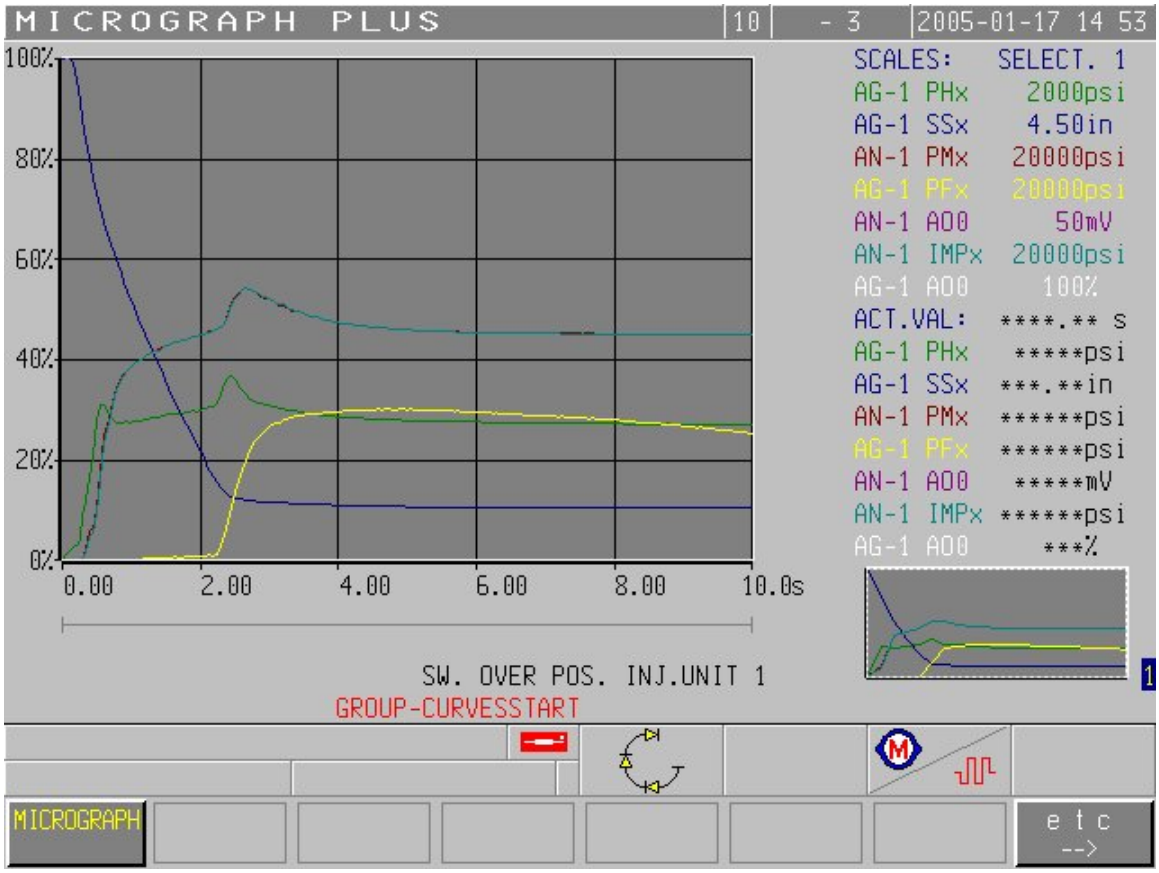
The following graphic depicts how PFA affects the IntelliMold™ process. The blue line represents cavity pressure; the red line represents nozzle pressure; the green line represents calculated Internal Melt Pressure (IMP). Notice that there are three separate scenarios for nozzle pressure. With PFA at –1, nozzle pressure is reduced when the cavity is introduced. With PFA at 0 there is no change in nozzle pressure. With PFA at +1 nozzle pressure is increased.



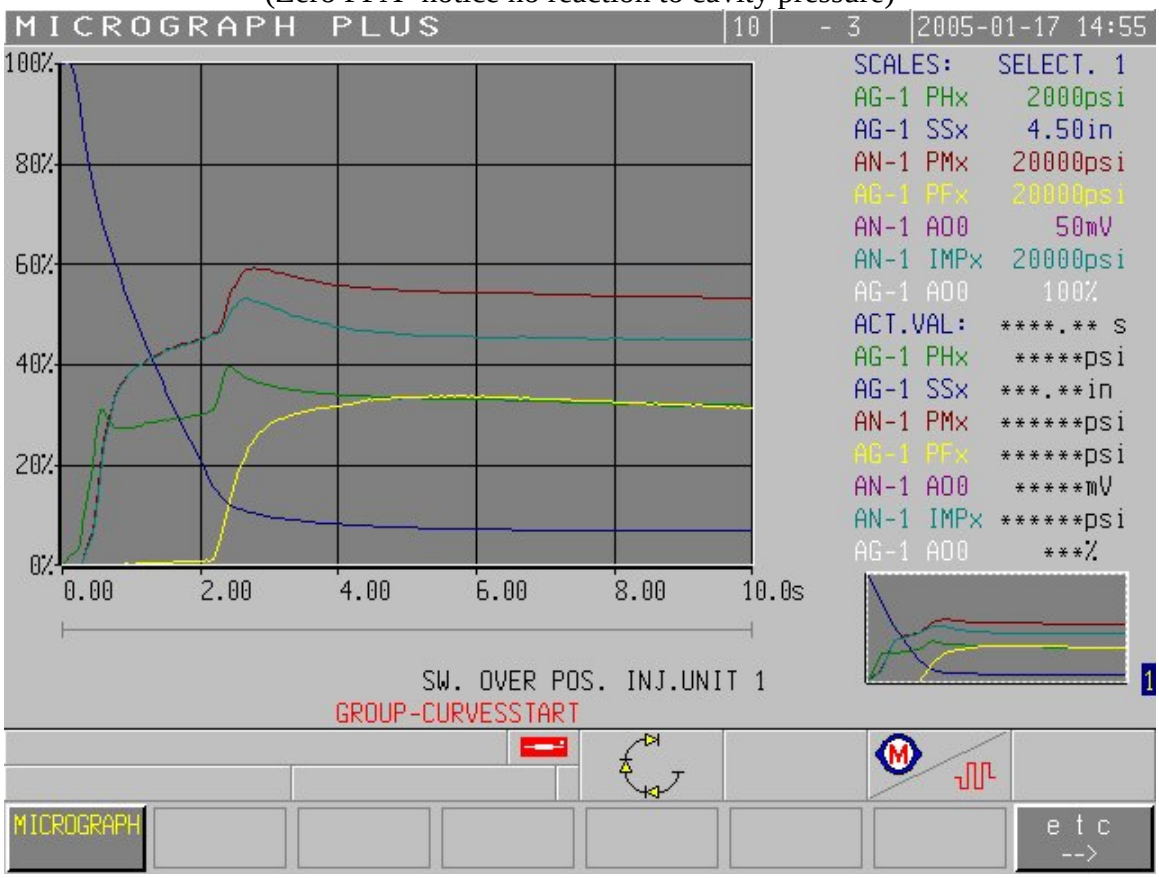


PROCESS FACTOR A:B

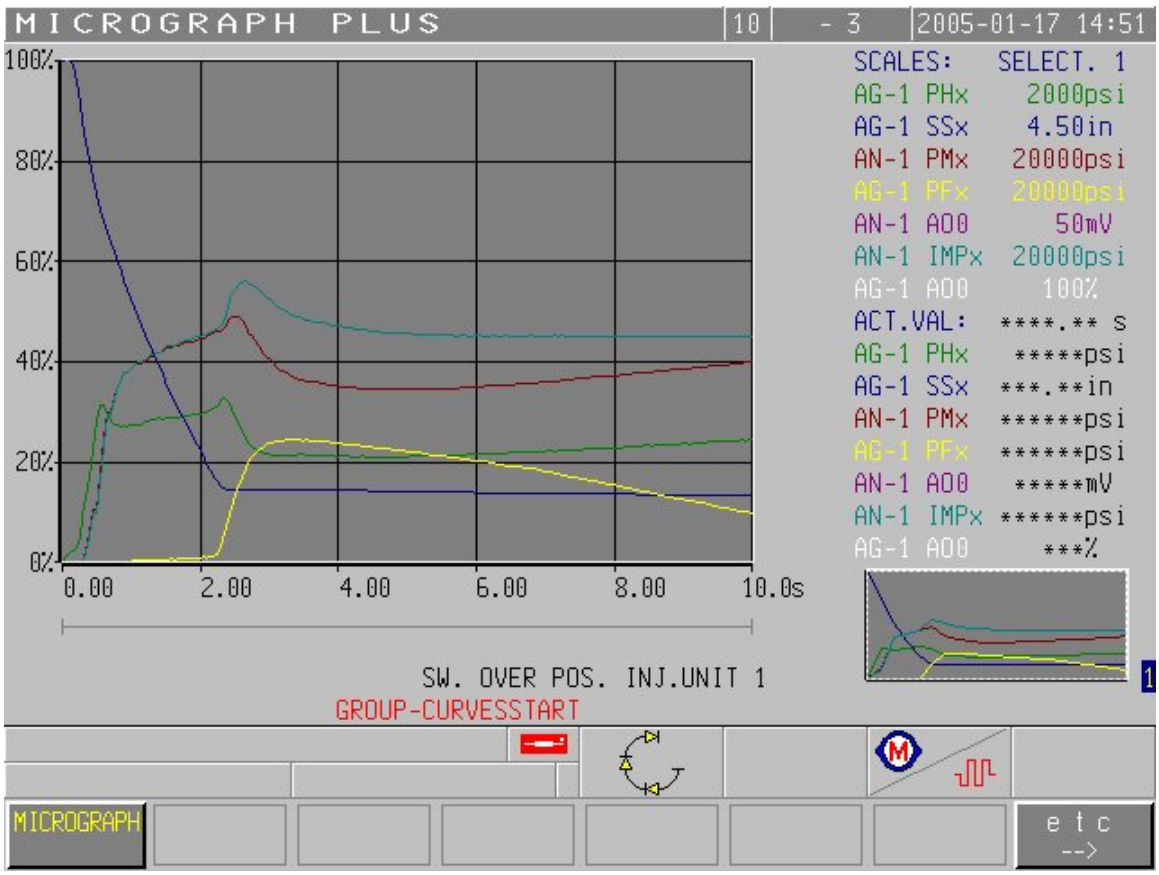




(Zero PFA- notice no reaction to cavity pressure)

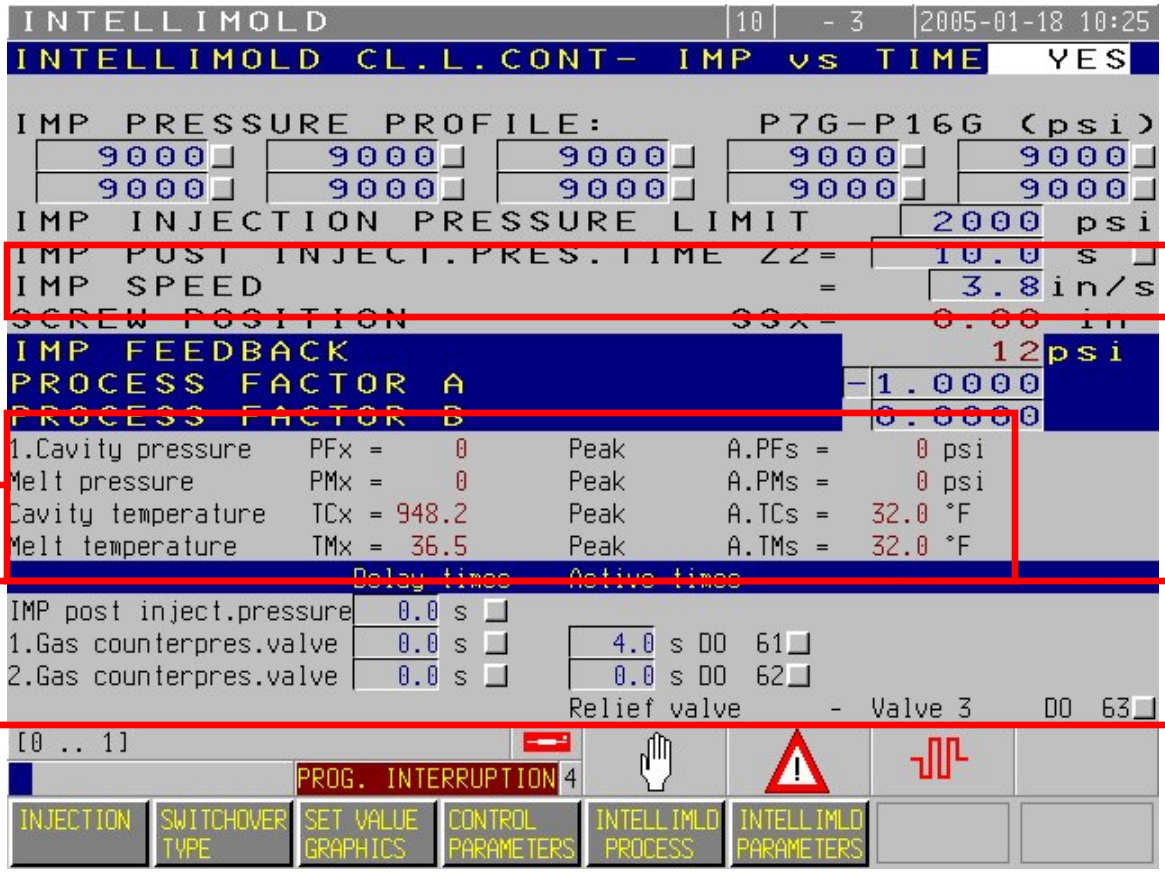


(+.25 PFA-notice pressure applied to nozzle signal responding to cavity press)



(-.5 PFA-notice negative response to cavity pressure)

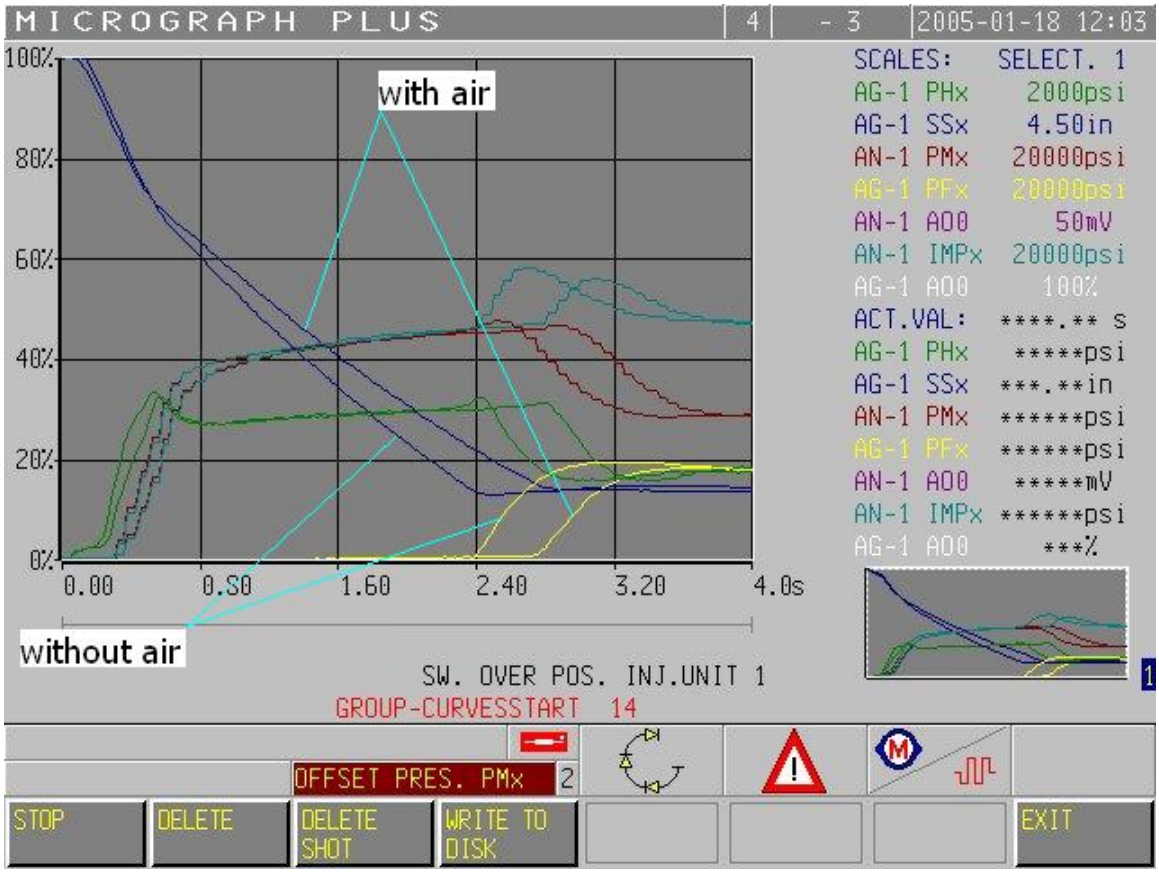
Preceding three graphs depict the various ways of Process Factor manipulation to directly affect the machine hydraulic pressure in reaction to the cavity pressure during a molding cycle.



This section of the Main IntelliMold™ Screen displays Peak and Actual values for Cavity Pressure, Melt Pressure, Cavity Temperature (if available), and Melt Temperature (if available).

The process timer set points control the amount of time that the solenoids on the pneumatic panel are energized. There is a delay time and an active time. The active time for **MP1 (Valve 1)** occurs when the delay time for **MP1 (Valve 1)** expires, as well as for **MP2 (Valve 2)**. All timers start at final injection permission. The box that appears to the right of the set point is highlighted when the solenoid is actually energized. There are three solenoids located on the pneumatic unit, the one not shown on the screen is the **MPR**, it is a normally open solenoid that is energized and closed whenever **MP1** or **MP2** is energized. This is done to release pressure between the pneumatic unit and the mold after injection. **Injection Delay** is provided in the event that additional time is needed to charge the cavity.

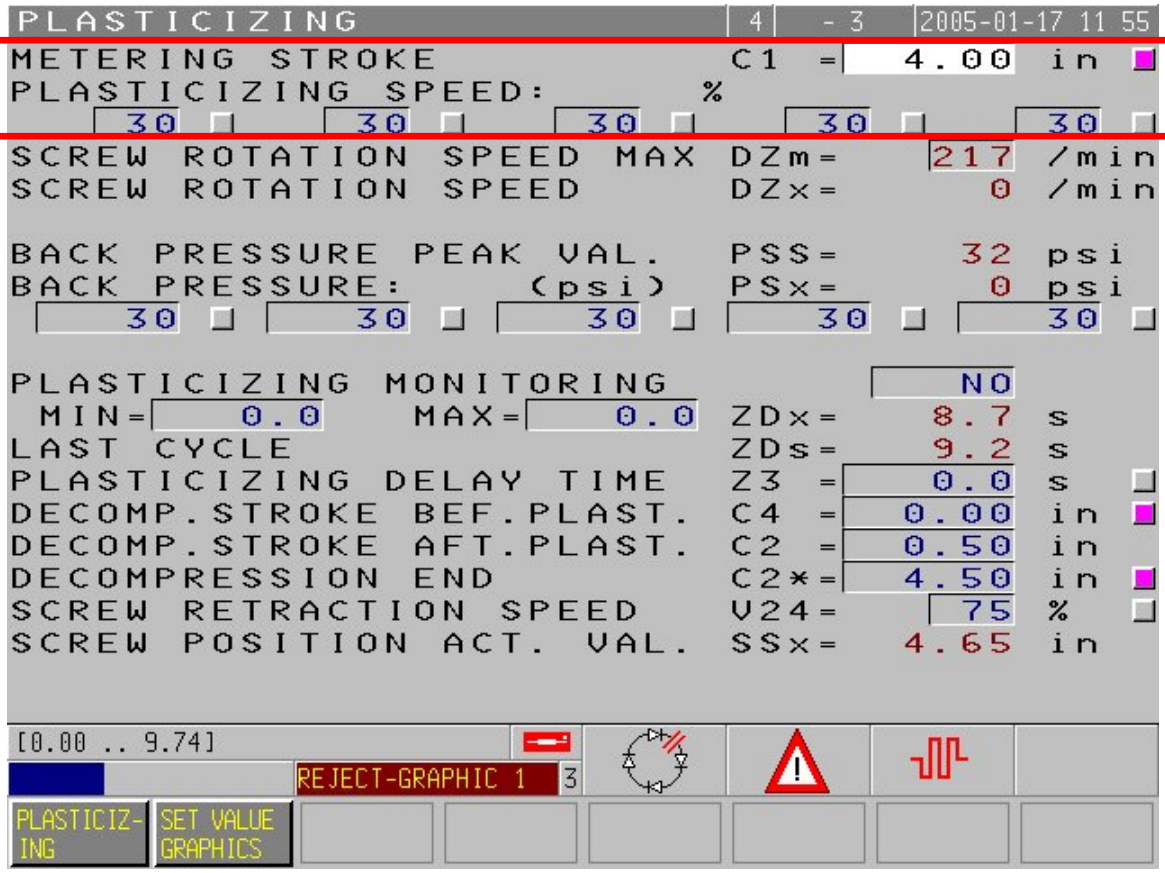
IMP Speed (IntelliMold™ Velocity Control) is used to limit the velocity of the injection unit while IntelliMold™ is enabled.



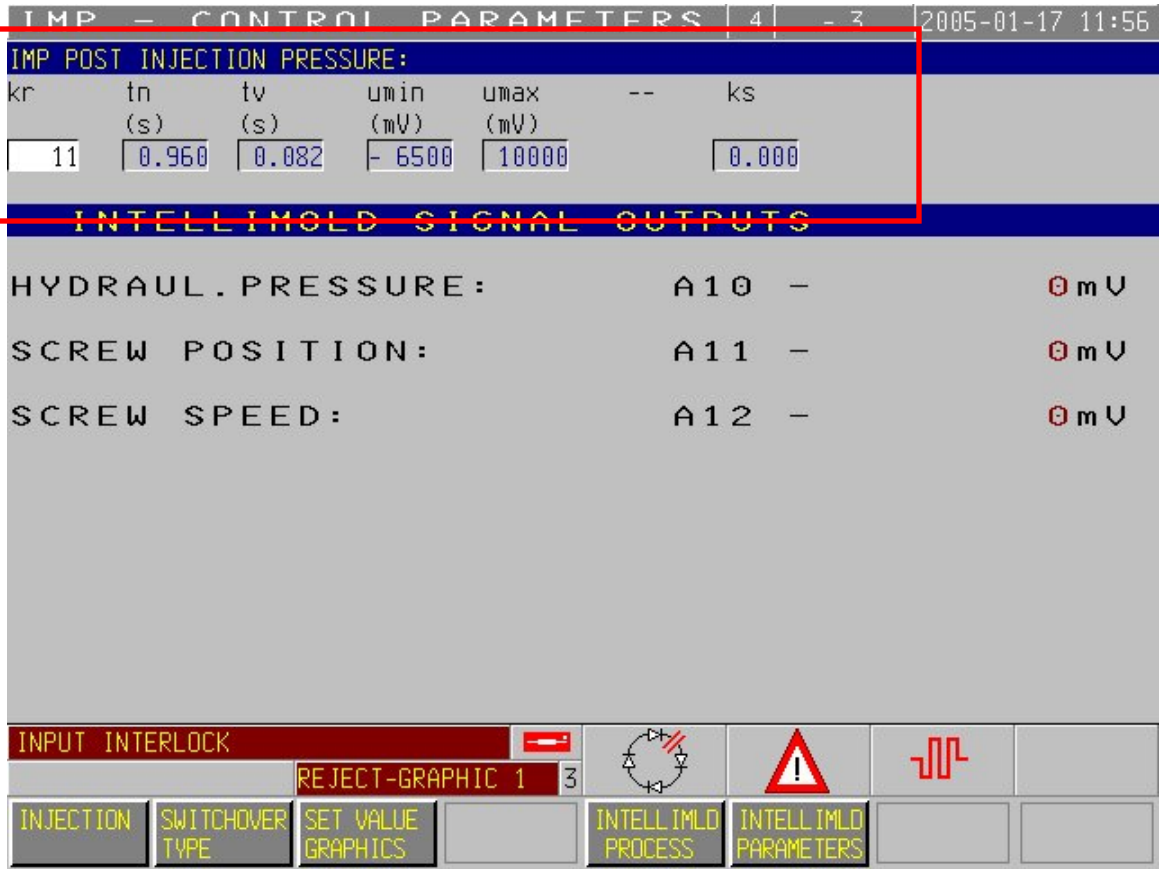
(Consecutive shots: One with air counter-pressure and one without counter-pressure)

The above screen shot depicts two cycles taken to show the difference between molding with the air counter pressure and without the counter pressure in the system. The difference in the two methods is clearly outlined by looking at the difference in the yellow lines (cavity pressure). The difference can also be seen in the actual shot size (dark blue line). The shot is faster without air counter pressure, which accounts for the increased speed of injection, showing internal melt pressure compensation within the control algorithms. This reaction gives Intellimold the ability to allow for product and process improvements depicted below.

Product Improvements	Process Improvements
Improved repeatability	Reduced cycle times
Higher surface quality	Real-time process control
Reduced warping, shrink and sinks	Error proofing
Stronger knit lines	Reduced scrap and re-work
Consistent part density	
Reduced internal stress	
Consistent weight	
Improved design flexibility	



The following screen is a conventional screen. Not all of the required set points are done from an IntelliMold™ Screen. Some very common parameters still need to be inputted from their Conventional Screens. Shot Size, Cooling Time, Decompress, etc.

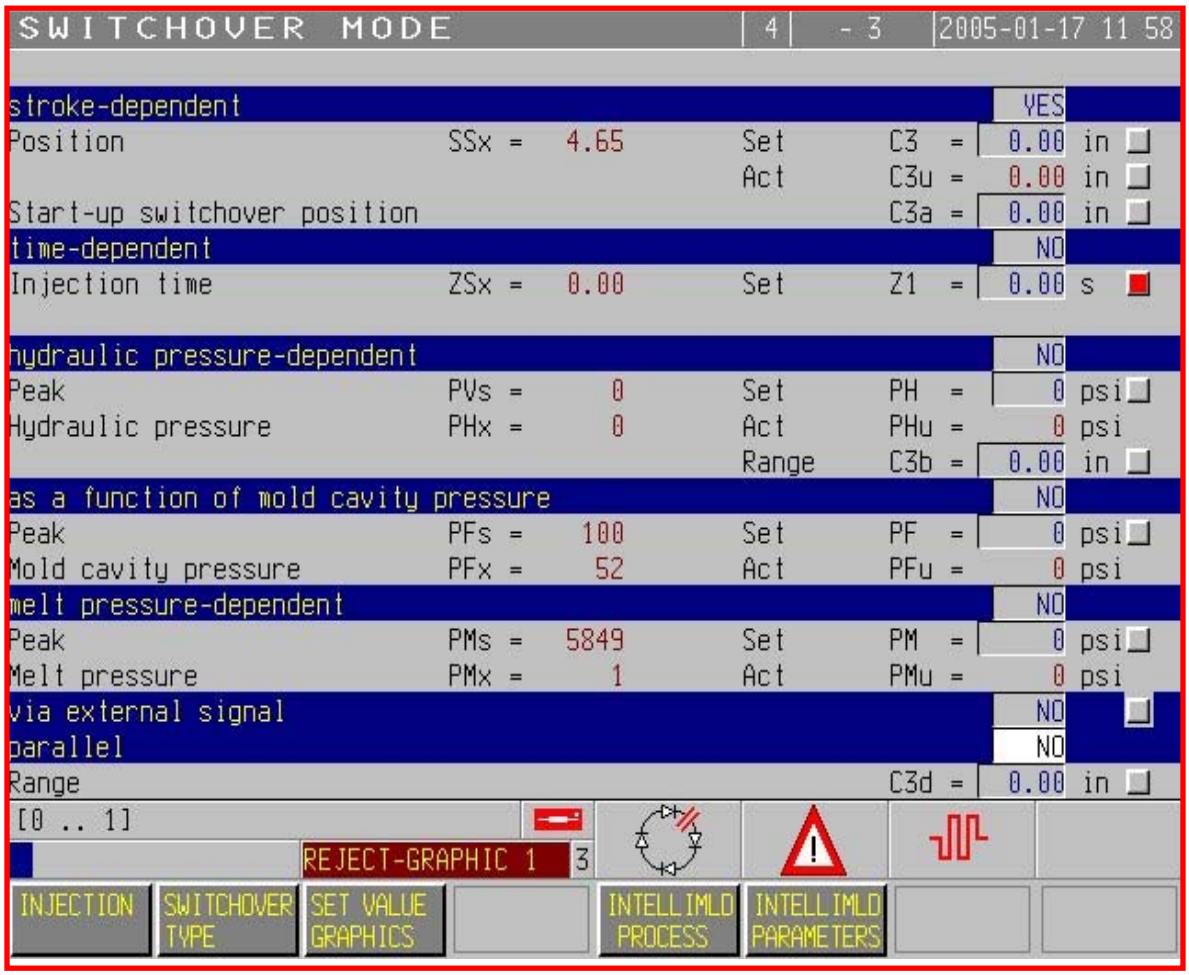


The above screen is used to adjust the **Kr**, **Tn**, **Tv**, **Umin**, and **Umax**. **Kr**, **Tn**, and, **Tv** typically know as **PID** are used tune the IMM to the IMP signal provided by Intellimold. **Kr** is the product of the proportional factor and the difference between the present set value and the last measured actual value. **Tn** is the product of the integral factor and the sum of all previous set value/actual value differences. **Tv** is the product of the differential factor and the value of the difference between the set values and the actual values of the current measurement the last measurement. **Umin** is set at minimum value limit, and **Umax** at maximum value limit.

The tuning information is only for general reference. The tuning values for each machine will be established by an Intellimold representative upon installation of the system. Adjustments to these tuning parameters should only be made by qualified personnel.

CROSS REFERENCE.

Kr = P (Closed Loop)
Tn = I
Tv = D
Ks = P (Open Loop)



The above screen is used select type of transfer. There are four different types of transfer, Screw Stroke Dependent (Position), Time Dependent, Hydraulic Pressure Dependent, and Cavity Pressure Dependent. When utilizing Intellimold™ Time Dependent should be the only transfer mode selected. All others should remain in the "NO" mode. The Time entered value needs to be 0.00 (zero). This will allow Intellimold to use value entered on the Main GCP screen. See page 4.

Revision History

Revision	Description	Revision Date
Rel.	Document Released	1/9/02
.001	Screens Changed by Scott Cameron + Dave Wills	1/18/05