Procedure for Determining Delta P

Goal: A machine, open or closed loop, electric or hydraulic, will attenuate reasonable viscosity variations during injection while producing parts providing it is set up with an appropriate Delta P. Delta P is the difference between the set 1st stage set pressure limit and the Peak pressure during injection or 1st stage. You should not set the 1st stage pressure limit to maximum unless necessary. If the Delta P is set too high and accidentally a gate blocks in a multi-cavity tool, you would flash excessively. This would flash slides and possibly damage the mold on subsequent mold closing. Use an appropriate Delta P, generally 200 -400 psi (14 – 28 bar) on most hydraulic machines and 1,500 – 3,000 psi (105 -210 bar) on most electric machines. To find a good Delta P, production viable, for a given machine, use a mold the takes 60 to 85% of the machines available pressure.

The procedure:

Caution: We strongly advise that you do not try this without at-the-press training. *There are safety concerns for personnel and the possibility of damaging the mold or machine if one does not understand the procedure correctly. This procedure involves using high temperatures, pressures and injection speeds. If at any time, you are unsure of what will happen stop and seek help*.

1. Bring the machine to steady-state operating conditions molding parts following all appropriate safety practices associated with the operation of an injection molding machine. Ensure you can read the peak hydraulic pressure during 1st stage or injection. This may not be the pressure at transfer, especially if you are profiling injection speeds (not recommended). Location of the pressure measuring device, gage or transducer, should be after the flow control valve or directly on the hydraulic injection cylinder. For electric machines use the pressure provided by the machine's manufacturer. Also, ensure you can measure the time from "injection-start" to when the screw reaches its cutoff (also known as transfer or switchover) position. This time is the Fill Time (FT). This timer should count up and read to 0.01 second (hundredths of a second).

2. Ensure the machine is set to transfer from first to second stage via screw position.

3. Do the viscosity curve experiment and determine the fill time for production; or use the fill time you have established as best for the part.

4. Make sure 2nd stage, pack and hold pressure is off. That is 2nd stage pressure is very low, for example: 10 psi (1 bar) hydraulic or 100-psi (7 bar) plastic pressure***, do NOT set hold time to zero unless necessary.*** Taking 2nd state off by removing time on the timer may cause excessive flash when you put time back on the timer. On some machines, you may have to eliminate pack-velocity; that is, set it to zero.

5. Ensure that the part will not stick if you make a significantly short shot. If you are sure you can eject an 80% full part, adjust the screw transfer position to achieve a ~ 80% short shot. Make sure the part is not filling during screw rotate. This can happen if the gate seal time is long and the backpressure is high enough to push plastic into the mold during screw rotate.

6. Adjust the first stage allowable timer to ~10 seconds. This is to make sure that there is always enough time on this timer for the screw to reach its cut-off position ***before*** this timer times out. For this step and the entire experiment note: ***It is critical that all, repeat all, shots are short and you are not bottoming the screw. Damage to the mold,***

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machine and/or you could result if you do not ensure short shots with some cushion.

7. Note peak pressure during 1st stage and compare it to the set 1st stage pressure limit. If peak pressure during injection is higher than set 1st stage set pressure limit, go to step 9. If peak pressure during injection is lower than set 1st stage pressure limit go to step 8.

8. Decrease the 1st set pressure limit until you significantly change (increase) the fill time. Normally this will be about 300 psi below peak pressure for hydraulic machines and for electrics about 1,500 to 2,000 psi below peak. Again, shots will be short so make sure they can be ejected. In this step, you are purposely running "pressure limited." Also, note that some machines significantly overshoot the set 1st stage limit pressure. That is, the set limit on the controller screen is lower then the actual peak pressure available.

9. Note 1st stage set pressure limit, Fill Time and Peak pressure during injection. See table below.

10. Once you are running pressure-limited increase 1st stage pressure limit by 100 to 200 psi (7 – 14 bar) for hydraulic machines, 500 to 1,000 psi (35 – 70 bar) for electric machines.

11. Repeat steps 10 & 11 until two criteria are met as you increase 1st stage set pressure limit. **At every shot, make sure you are making a short shot with some cushion!**
    A Fill Time stops dropping and becomes constant
    B Peak pressure stops trending up
    *Please note that you may **not** find the correct Delta P as the machine may not have enough injection pressure available.*
12. Develop a table of the data as shown in the table below:

Delta P Data

Shot	Set Pressure	Fill Time	Peak Pressure	Delta P	
#	psi or bar	Seconds	psi or bar	psi	
1	1,200	1.50	1,156	44	Bad
2	1,300	1.39	1,229	71	Bad
3	1,400	1.38	1,244	156	Bad
4	1,500	1.24	1,355	145	Bad
5	1,600	1.25	1,376	224	Bad
6	1,700	1.22	1,453	247	Bad
7	1,800	1.22	1,467	333	Bingo
8	1,930	1.22	1,460	470	OK

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