

Contents

Preface	IX
1 Introduction	1
1.1 General Aspects of Hot Runner Technology	1
1.2 Design of Hot Runner Systems and Nomenclature of Components	6
1.3 Design of Single Components Used for Hot Runner Systems ..	7
2 Basic Aspects of Heat Technology	9
2.1 Heat Transfer	10
2.1.1 Heat Conduction	10
2.1.2 Convection	16
2.1.3 Radiation	19
2.1.4 Summary	23
2.2 Amount of Heat, Heating Capacity	24
2.3 Heat Expansion	26
3 Introduction of Hot Runner Components	37
3.1 Hot Runner Manifold Block	37
3.1.1 Externally Heated Hot Runner Manifold Blocks	41
3.1.2 Internally Heated Hot Runner Manifold Blocks	46
3.1.3 Insulated Runner System	49
3.1.4 Rheological Design	52
3.1.4.1 Natural Balancing	52
3.1.4.2 Numerical Balancing	54
3.2 Reflector- and Thermal Insulating Sheets, Surface Coating	56
3.3 Melt Chamber Bushing	61
3.4 Distributor Bushing	63
3.5 Spacer Disks	66
3.6 Anti-Twist Device for Hot Runner Block	78
3.7 Turn Plugs	79
3.8 Hot Runner Nozzles	82
3.8.1 General Aspects	82
3.8.2 Open Hot Runner Nozzle	83
3.8.3 Open Multiple Gate Nozzles	89
3.8.3.1 “Vertical” of Nozzle Tip Design	89

3.8.3.2	“Slanted” Design of Nozzle Tips	99
3.8.3.3	“Horizontal” Tip Design	101
3.8.3.4	“Edge” Gating without Tips	104
3.8.4	Shut-Off Nozzles	107
3.8.4.1	Needle Shut-Off Systems	108
3.8.4.2	Thermal Shut-Off-Nozzles	140
4	Heating of Hot Runner Manifold Blocks	147
4.1	Cylindrical Cartridge Heater	148
4.2	Tapered Cartridge Heater	150
4.3	Threaded Cartridge Heater	151
4.4	Tubular Heater	152
4.5	Heater Plate	155
4.6	“Thick-Film”- Heating Element	157
4.7	Indirect Heating Using a Liquid Medium	158
4.8	Heat Pipe	159
4.9	Determination of Heating Capacity of an Externally Heated Hot Runner Manifold Block	160
4.9.1	Estimate of Required Heating Capacity	160
4.9.2	Numerical Determination of Heating Capacity to be Installed for the Heat-up Phase	161
5	Heating of Hot Runner Nozzles	165
5.1	Cylindrical Cartridge Heater	165
5.2	Coiled Heater	166
5.3	Resistor Heater	170
5.4	Heat Pipe	173
5.5	Indirect Heating Using a Liquid Medium	174
5.6	General Remarks Regarding Internal Heating (“Conductive Heating”)	177
5.7	Indirect Heating	181
5.7.1	Thermally Conductive Torpedoes	181
5.7.2	Thermally Conductive Nozzle	186
6	Measurement and Control of Temperature	193
7	Material Behavior under Mechanical Load	195
7.1	Notch Effect under Static Load	195
7.2	Notch Effect under Dynamic Load	198

8 Corrosion and Wear	201
9 Screw Connections and Material Selection for Elevated Temperatures	207
10 Basic Aspects of Plastics Technology	211
10.1 Flow Characteristics, Viscosity, Pressure Loss	211
10.2 Thermal Stability	215
10.3 Decrease of Molecular Weight (Exemplified by PBT)	217
10.3.1 Thermal Degradation	217
10.3.2 Mechanical Degradation	219
10.3.3 Oxidative Degradation	219
10.3.4 Hydrolytic Degradation	220
11 Maintenance and Storage of Hot Runner Molds	221
12 Design of Special Hot Runner Systems and Hot Runner Molds ..	223
12.1 300-Fold Hot Runner System for the Production of Transistor Housings Made of Reinforced PBT	223
12.2 Hot Runner Manifold Block for Sandwich Molding	226
12.3 Hot Runner System with Balanced Filling Action	228
12.4 Hot Runner Nozzles for Small Center-to-Center Cavity Space ..	229
Appendix 1:	
Abbreviations Used in this Book	233
Appendix 2:	
Conversion Factors for Units of Measure	235
Index	239