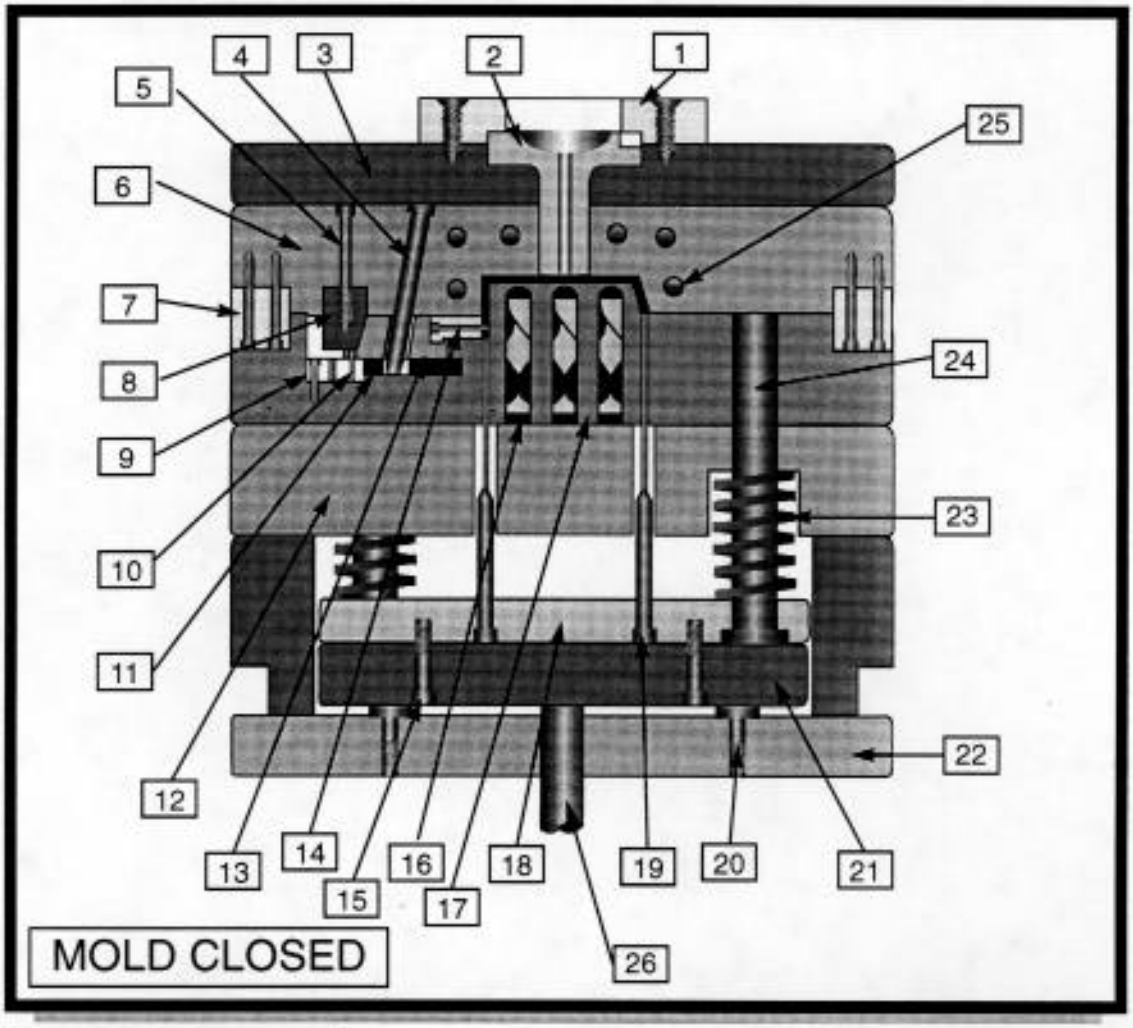
CONTENTS: TOOL DESIGN

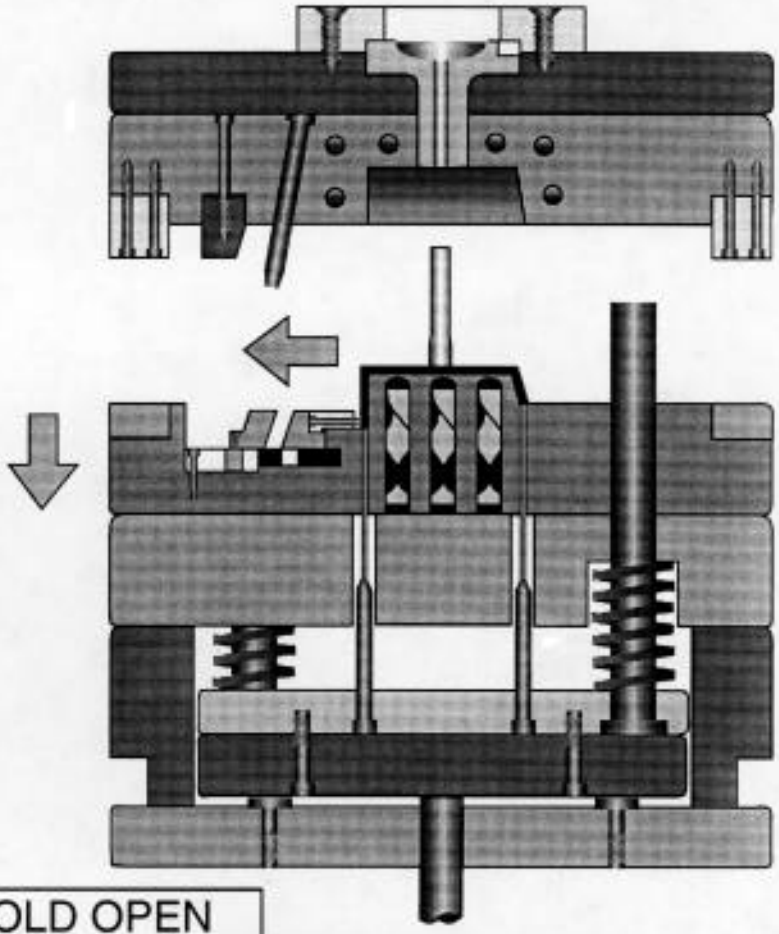
MOLD DESIGN BASICS



COMPONENTS

1. LOCATING RING
2. SPRUE BUSHING
3. TOP CLAMPING PLATE
4. ANGLE PIN
5. SOCKET HEAD BOLT
6. A PLATE
7. GUIDE LOCK
8. WEDGE LOCK
9. RETAINER
10. DOWEL PIN
11. WEAR PLATE
12. SUPPORT PLATE
13. SLIDE
14. CORE PIN
15. SOCKET HEAD BOLT
16. BAFFLE
17. 'B' PLATE
18. EJECTOR RETAINER PLATE
19. EJECTOR PIN
20. STOP PIN
21. EJECTOR PLATE
22. EJECTOR HOUSING
23. RETURN SPRING
24. RETURN PIN
25. COOLING CHANNEL
26. EJECTOR SHAFT

MOLD DESIGN BASICS

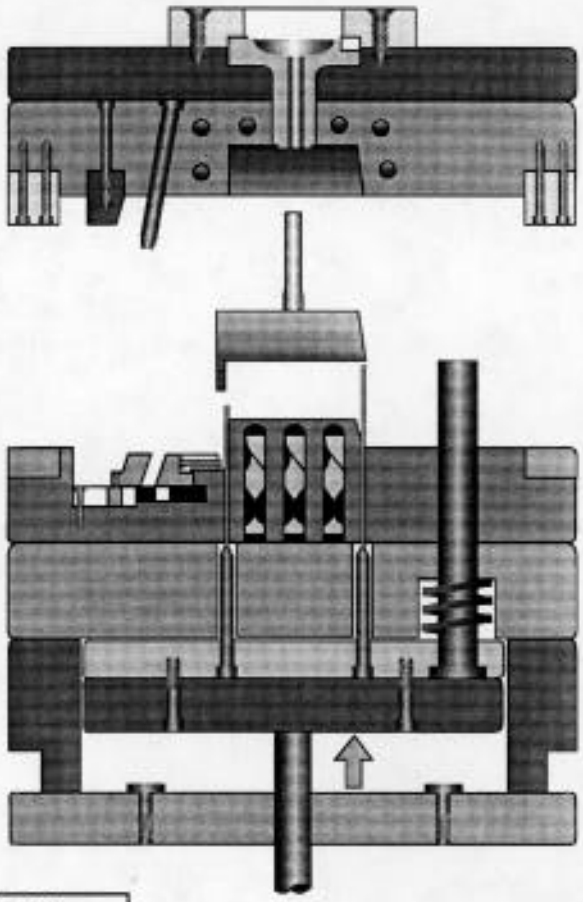


MOLD OPEN

SEQUENCE

- MOLD SEPARATES AT PARTING LINE
- ANGLE PIN PULLS SLIDE AWAY FROM PART
- DOWEL PIN IS CAPTURED BY RETAINER

MOLD DESIGN BASICS

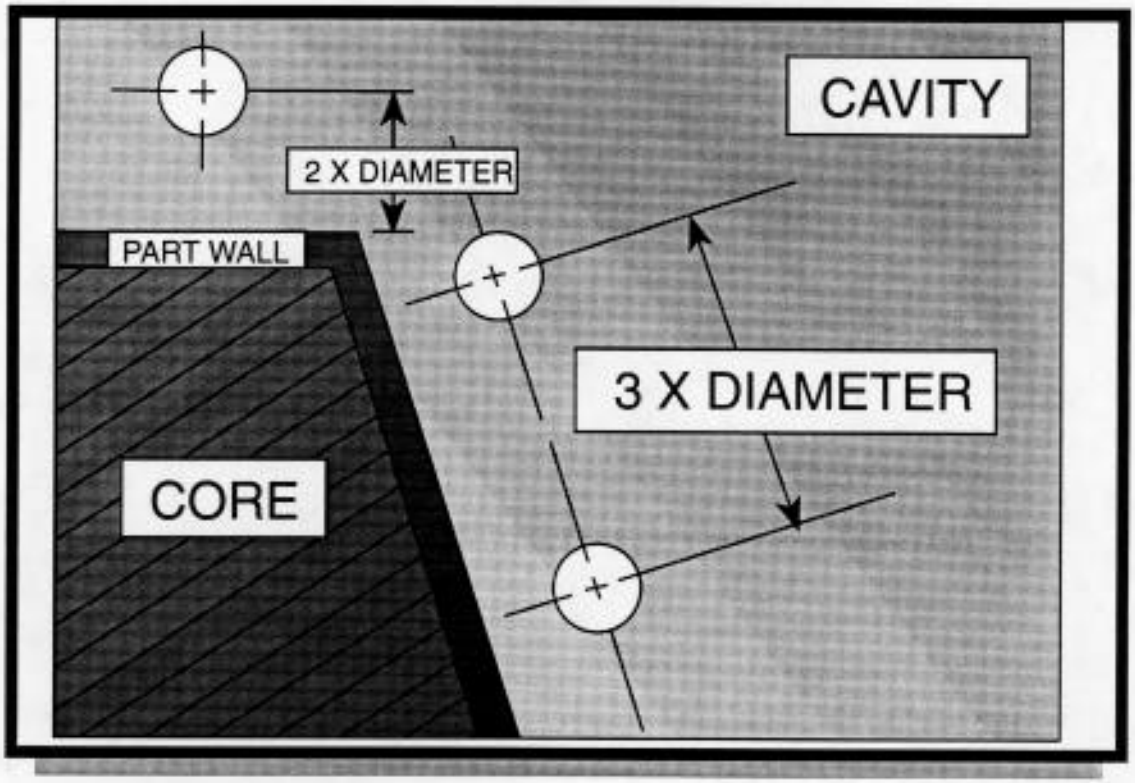


EJECTION

SEQUENCE

- EJECTOR SHAFT COMES FORWARD
- EJECTOR RETAINER PLATE FORCES PINS FORWARD
- EJECTOR PINS STRIP PART FROM CORE

CAVITY COOLING



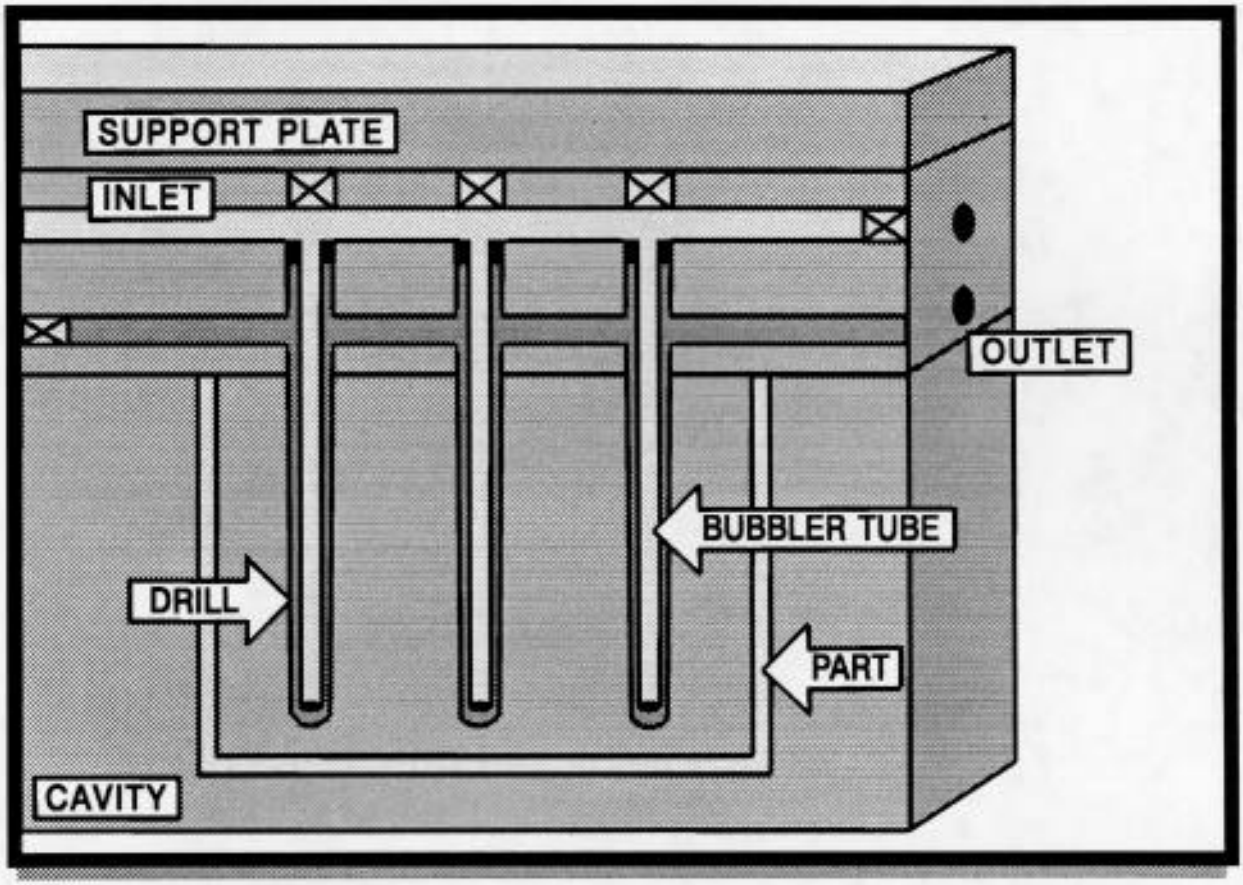
CRITICAL CONSTRAINTS

- 2 TIMES LINE DIAMETER FROM EDGE OF STEEL.
- 3 TIMES LINE DIAMETER BETWEEN LINES.

NOTES

- BALANCED MOLD TEMPERATURE CONTROL PRODUCES LESS MOLDED–IN STRESS, DIFFERENTIAL SHRINKAGE AND WARPAGE.
- GOOD COOLING IS ESSENTIAL FOR MINIMIZATION OF CYCLE TIMES.

CORE COOLING / BUBBLERS



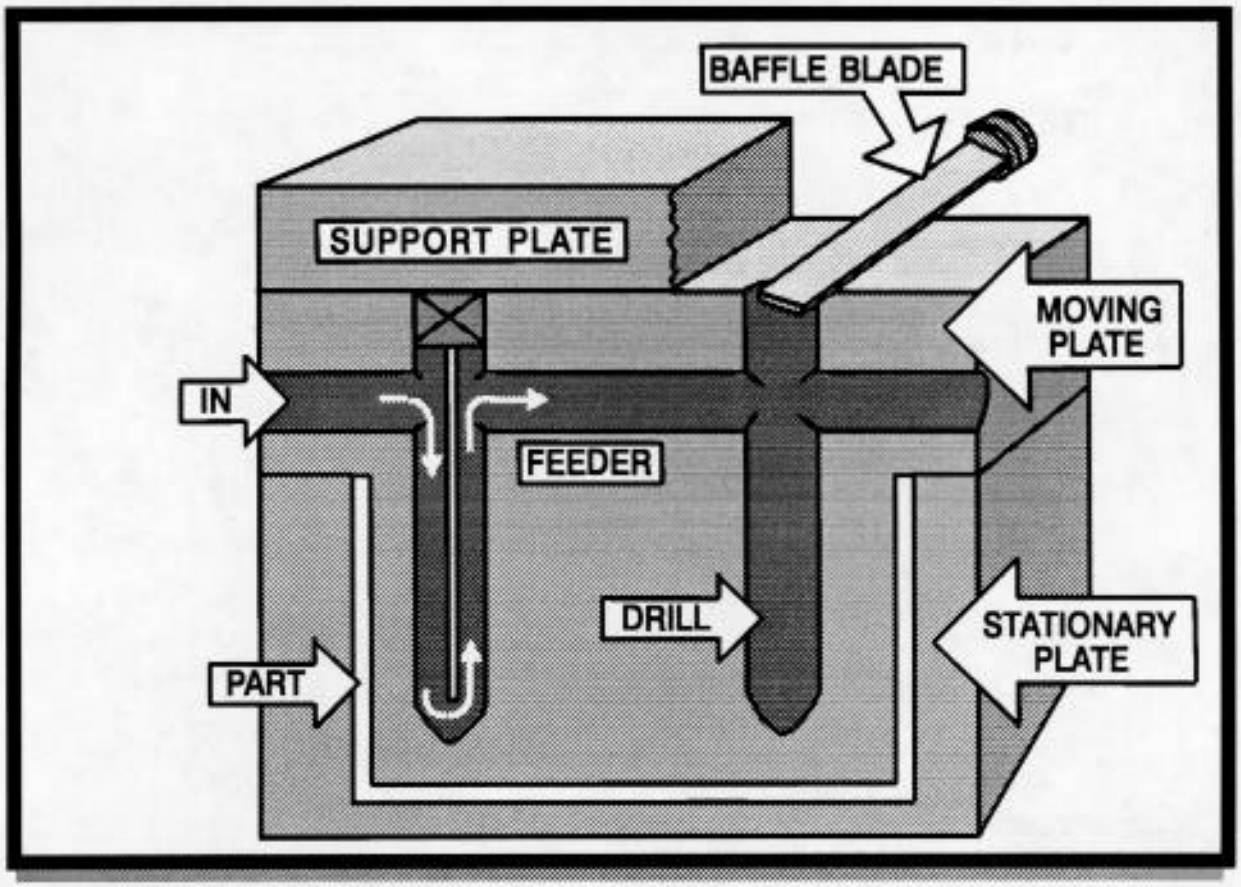
CRITICAL CONSTRAINTS

- DRILL DIAMETER, TUBE SELECTION, SUGGESTED FEEDER SIZE AND REQUIRED WATER FLOWRATE.

NOTES

- INCLUDED IN THE DESIGN AND ENGINEERING HANDBOOK IS A DISKETTE CONTAINING THE FLOWRATE CALCULATOR PROGRAM.
- THE PROGRAM MAY BE USED TO DESIGN NEW LINES OR TROUBLESHOOT EXISTING LINES.

CORE COOLING / BAFFLES



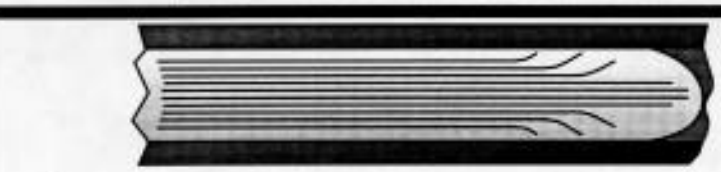
CRITICAL CONSTRAINTS

- DRILL DIAMETER, BLADE SELECTION, SUGGESTED FEEDER SIZE AND REQUIRED WATER FLOWRATE.

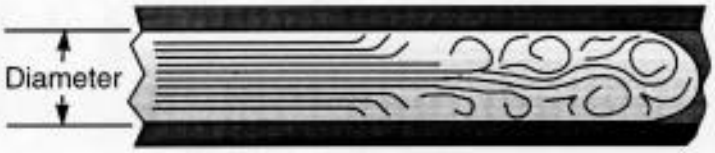
NOTES

- INCLUDED IN THE DESIGN AND ENGINEERING HANDBOOK IS A DISKETTE CONTAINING THE FLOWRATE CALCULATOR PROGRAM.
- THE PROGRAM MAY BE USED TO DESIGN NEW LINES OR TROUBLESHOOT EXISTING LINES.

COOLANT FLOW RATE



Laminar Flow Rate
Poor Heat Transfer



Turbulent Flow Rate
Improved Heat Transfer

REYNOLDS NUMBER FORMULA

$$Nr = \frac{3160\ Q}{Dn}$$

Q: Coolant Flow Rate in GPM

D: Diameter of Passage in Inches

n: Kinematic Viscosity in Centistokes

CRITICAL CONSTRAINTS

- REYNOLDS NUMBER OF 6000 SHOULD ENSURE TURBULENT FLOW RATE
- ETHYLENE GLYCOL SHOULD NOT BE USED AS COOLANT FOR AMORPHOUS POLYESTER MATERIALS DUE TO ITS HIGH VISCOSITY WHICH WOULD REQUIRE EXCESSIVE FLOW RATE TO ACHIEVE TURBULENCE.
- FLOW RATE CALCULATOR PROGRAM WILL PROVIDE GPM REQUIRED TO ACHIEVE TURBULENCE IN STANDARD CHANNEL, BAFFLE AND BUBBLER CONFIGURATIONS.

NOTES

- INCLUDED IN THE DESIGN AND ENGINEERING HANDBOOK IS A DISKETTE CONTAINING THE FLOW RATE CALCULATOR PROGRAM.

DRYING CONDITIONS CHECKLIST

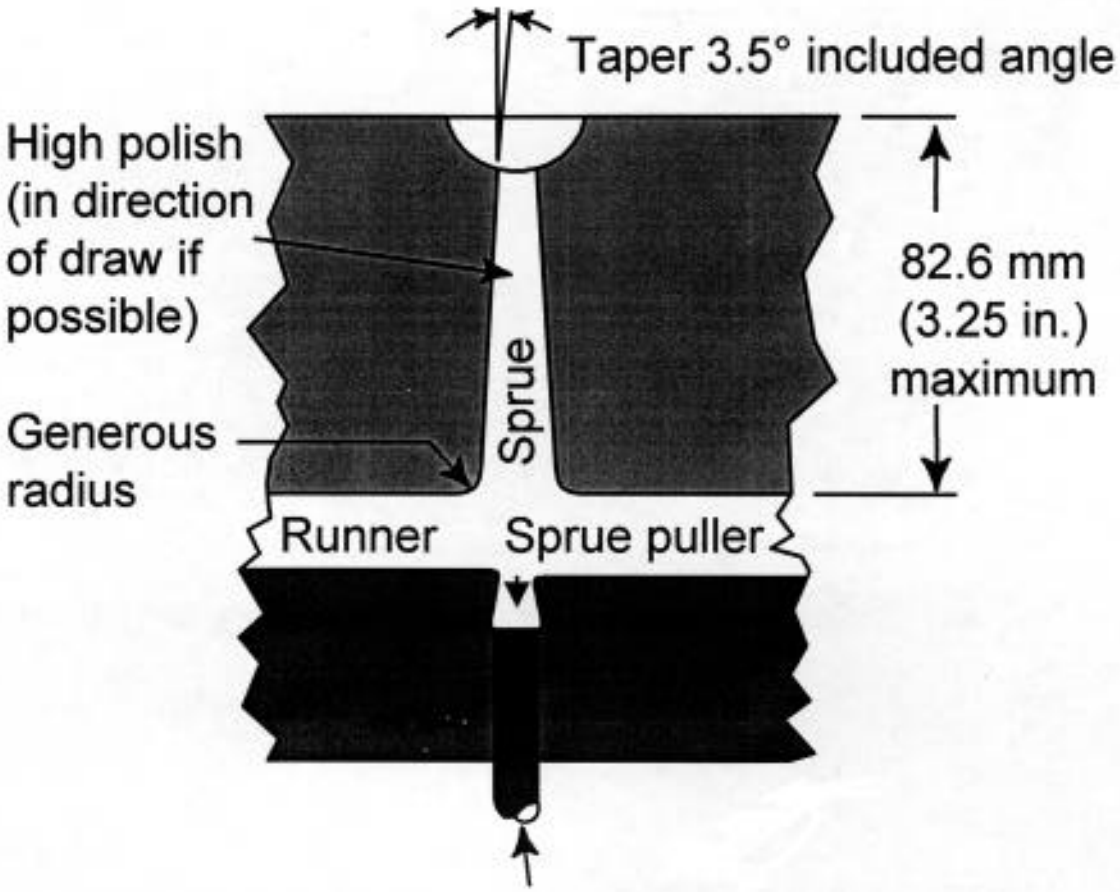
Drying Conditions Checklist

- ☐ Acceptable Dew Point
- ☐ Return Air Temperature
- ☐ All Regeneration Heaters Functional
- ☐ All Filters Serviced
- ☐ No Holes, Cracks Or Tears In Hoses
- ☐ Correct Hoses For Application
- ☐ Desiccant Changed Within Last Six Months
- ☐ Desiccant Beds Index As Scheduled
- ☐ Loader System Maintaining Correct Level In Hopper
- ☐ No Extreme Temperatures Swings During Drying
- ☐ Residence Time
- ☐ Air Flow Rate

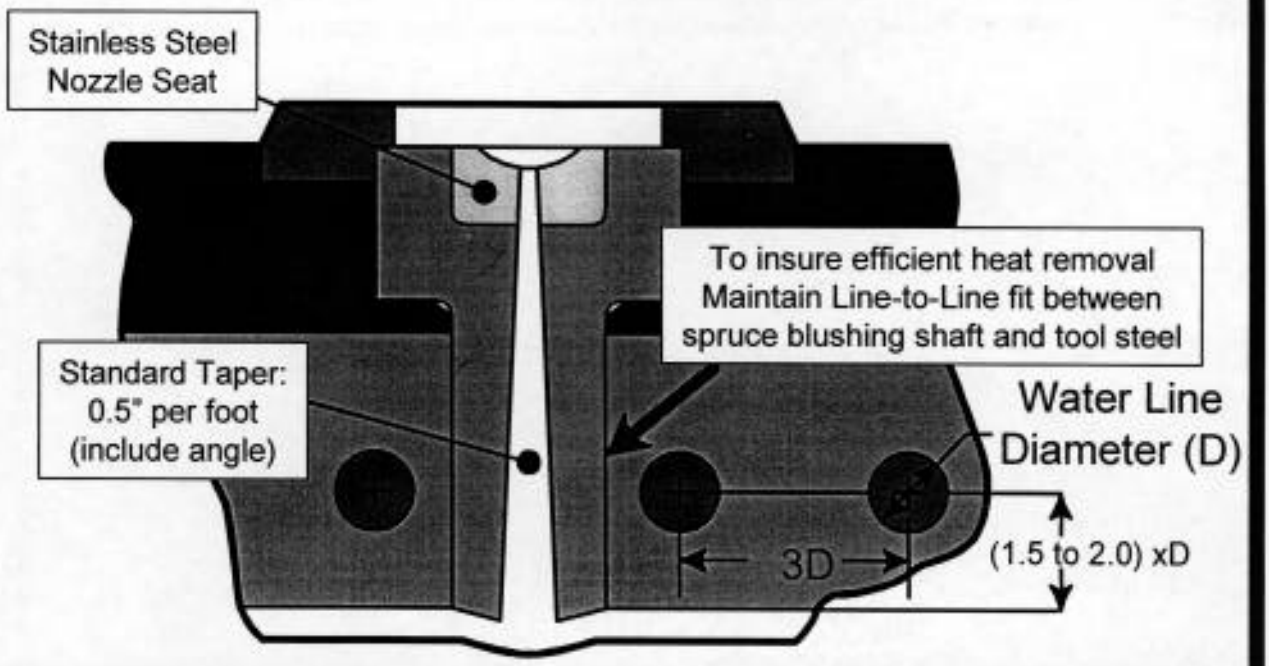
CRITICAL CONSTRAINTS

- DRYING IS ESSENTIAL IN PROCESSING POLYESTER MATERIALS.

SPRUE DESIGN



AMPCO 940® SPRUE BLUSHING

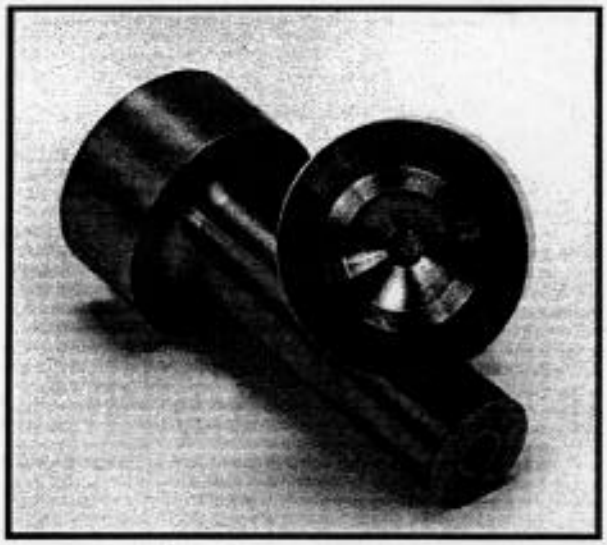


NOTES

AMPCO 940 THERMAL CONDUCTIVITY IS
6 TIMES GREATER THAN P20 TOOL STEEL

COLD SPRUE BUSHING

Ampcoloy 940 Sprue Bushing



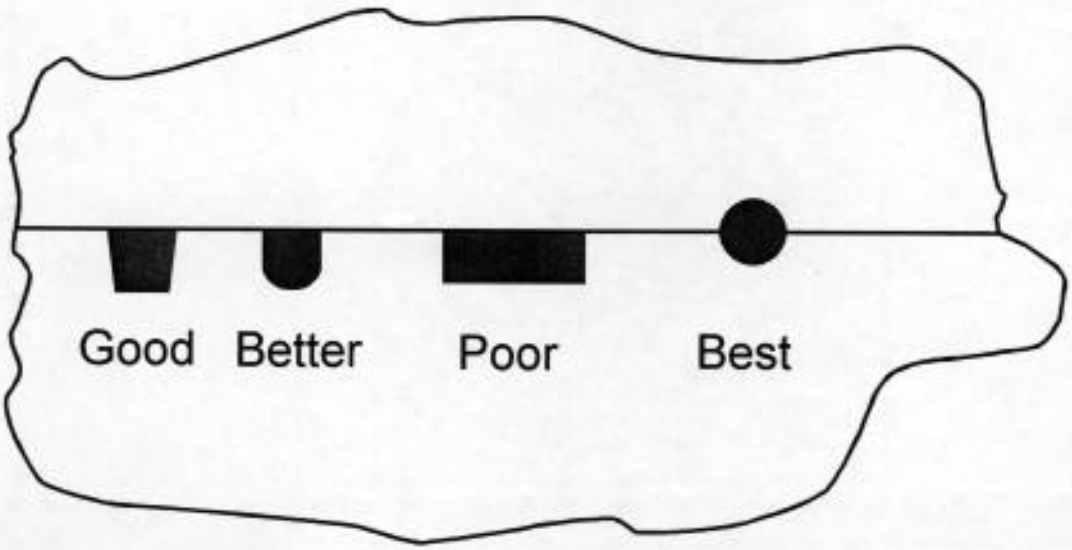
CRITICAL CONSTRAINTS

- THERMAL CONDUCTIVITY IS CRITICAL FOR *AMORPHOUS* POLYESTER MATERIALS.

NOTES

- AMORPHOUS POLYESTER MATERIALS REQUIRE A WELL COOLED SPRUE BUSHING TO MAINTAIN A GOOD CYCLE TIME.
- TYPICALLY THE BASE OF THE SPRUE IS THE THICKEST WALL SECTION ON THE MOLDED PART. ADEQUATE COOLING OF THIS AREA WILL HELP ACHIEVE GOOD CYCLE TIMES.
- THE THERMAL CONDUCTIVITY OF AMPCOLOY 940 IS 6 TIMES THAT OF TOOL STEEL.
- THE AMPCOLOY 940 BUSHING IS SUGGESTED FOR AMORPHOUS POLYESTERS. IT IS AVAILABLE THROUGH D&L INCORPORATED (Ph 1-800-269-6653).

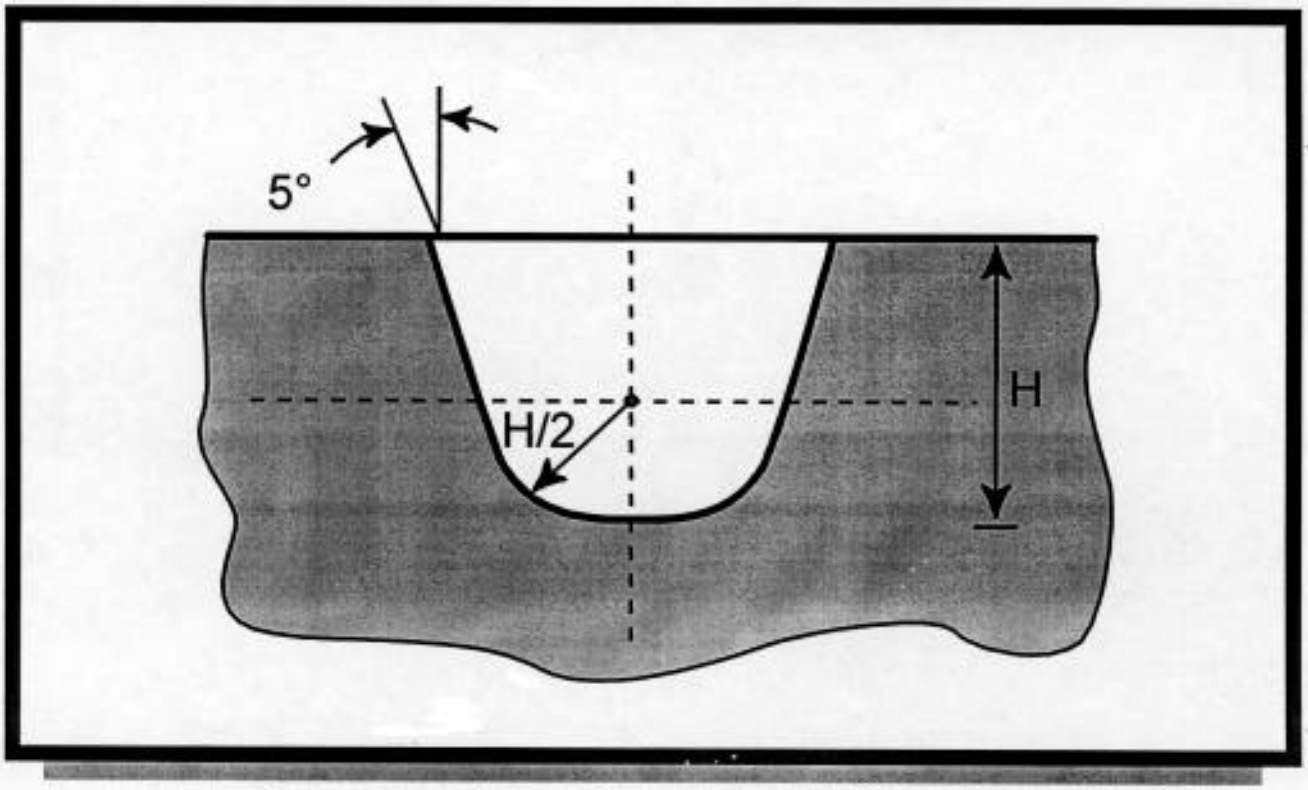
RUNNER DESIGN GUIDELINES



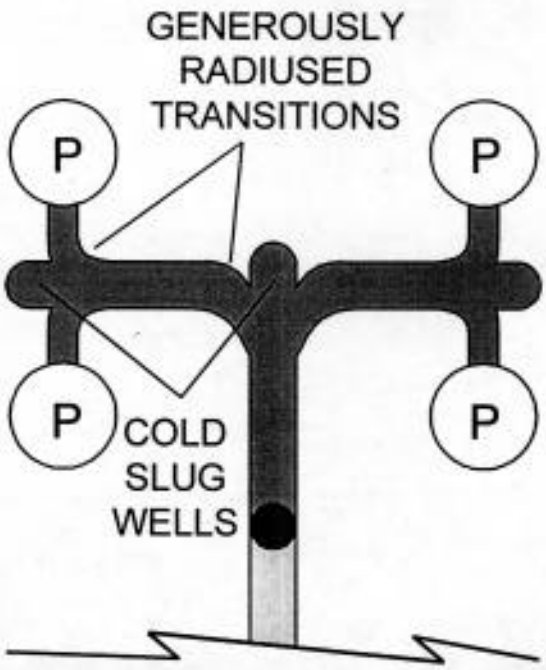
NOTES

- FLOW EFFICIENCY INCREASES AS THE CROSS-SECTION APPROACHES A CIRCULAR SHAPE

HALF ROUND RUNNER DESIGN



COLD RUNNER DESIGN



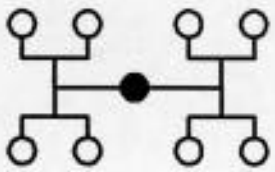
NOTES

- DESIGN FOR SMOOTH FULLY BALANCED FLOW
- GENEROUSLY RADIUSED TRANSITIONS TO REDUCE MATERIAL HANG-UP AND SHEAR
- COLD SLUG WELLS TO TRAP MATERIAL AT THE FLOW FRONT

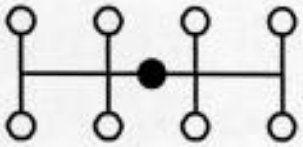
BALANCED RUNNERS

SYMETRICAL LAYOUT

- EQUAL FLOW LENGTH TO ALL CAVITIES WITHOUT GATE OR RUNNER CORRECTION

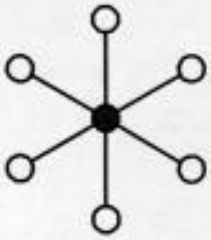


LAYOUT IN SERIES



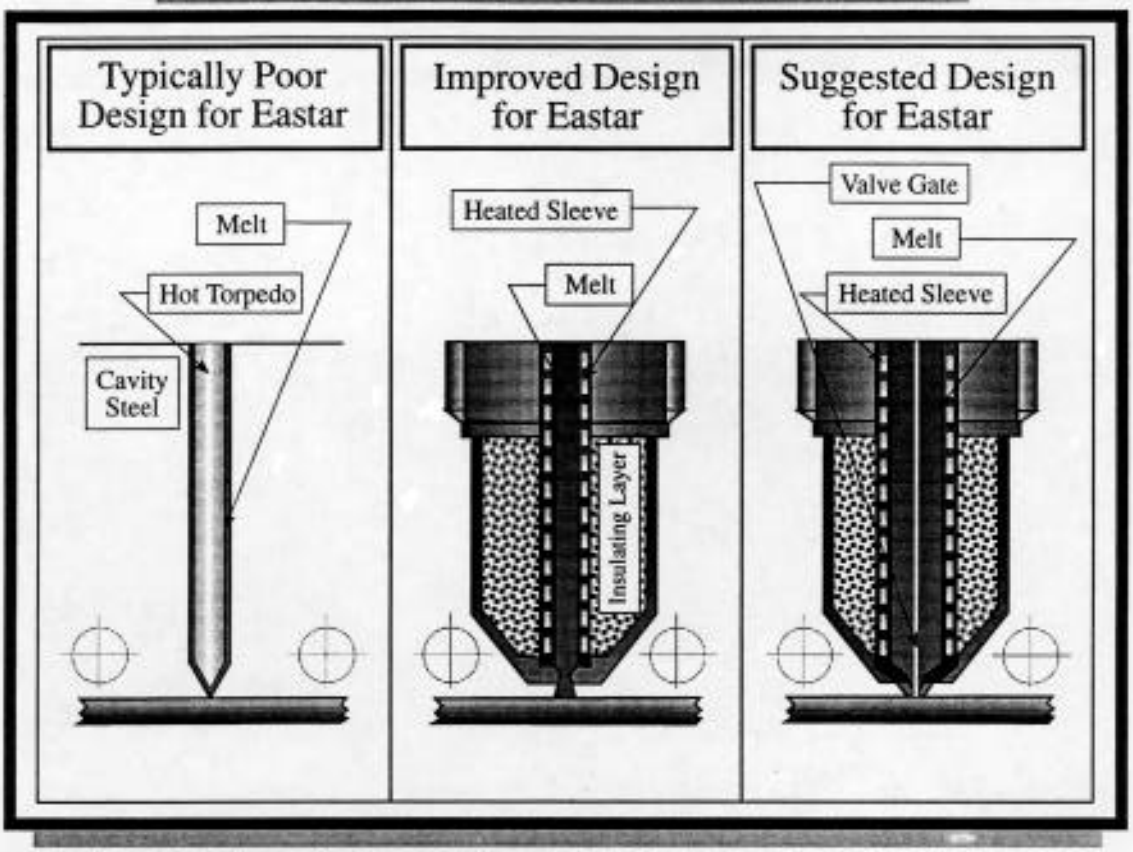
- LESS RUNNER SCRAP
- NEED TO BALANCE BY CHANGING RUNNER SEGMENT DIMENSIONS
- MAY BE DIFFICULT WHEN CHANGING MATERIAL

CIRUCLAR LAYOUT



- LIMITED NUMBER OF CAVITIES

HOT RUNNER SELECTION



CRITICAL CONSTRAINTS

- INSULATE MELT FROM COOLED STEEL
- DEDICATED WATER SUPPLY TO TIP
- MECHANICAL VALVE GATE
- NO MATERIAL HOLD–UPS
- DEDICATED THERMAL CONTROLLER FOR EACH TIP

NOTES

- MELT SHOULD BE INSULATED FROM COOLED STEEL OF CAVITY TO PREVENT PARTIAL FREEZE OFF OF OUTER MELT SKIN, CAUSING HIGH INJECTION PRESSURES AND POTENTIAL DISCOLORATION, STREAKS OR DEGRADATION.

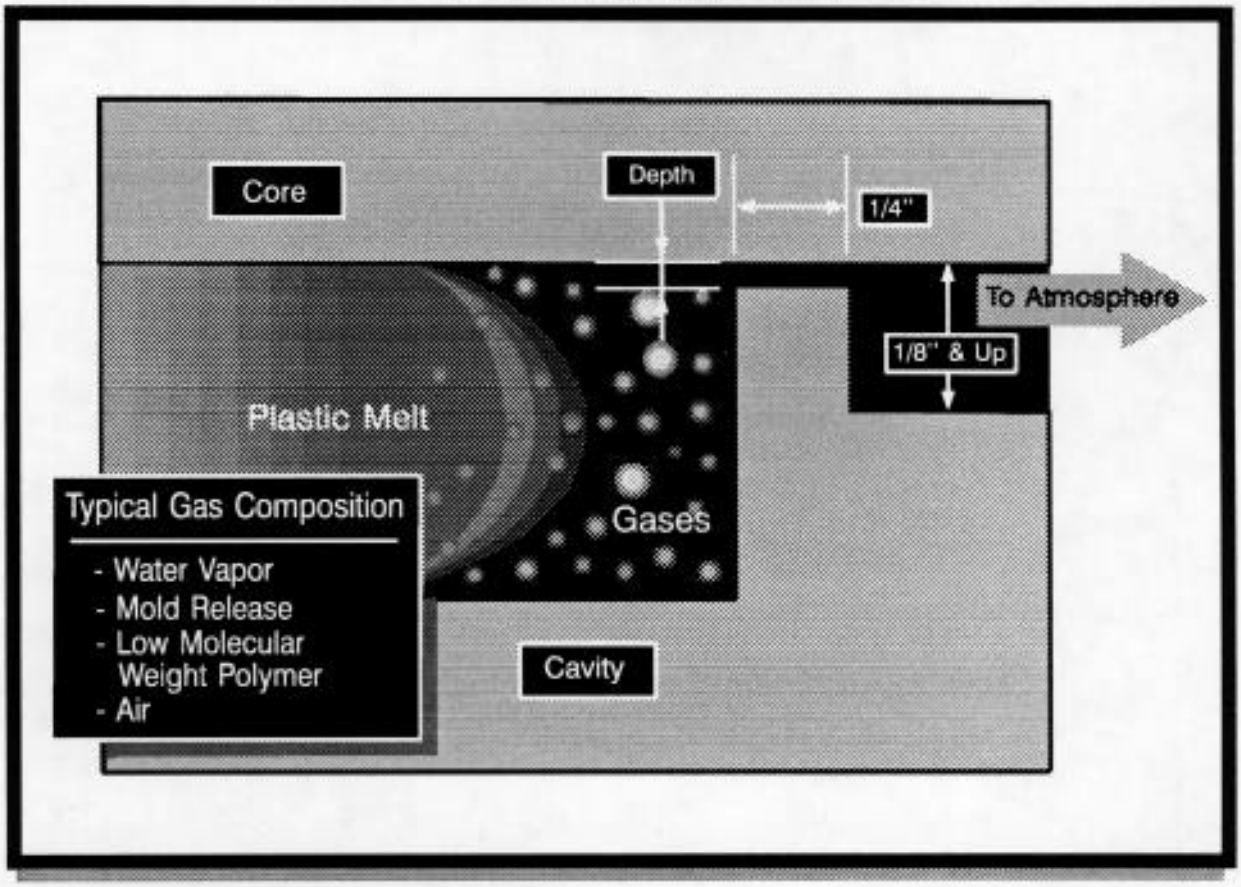
NOTES CONTINUED ON NEXT PAGE

HOT RUNNER SELECTION

NOTES

- DEDICATED WATER LINES ALLOW INCREASED TEMPERATURE CONTROL. GATE MUST BE COOLED QUICKLY TO PREVENT STICKING OR STRINGING.
- A MECHANICAL VALVE GATE ALLOWS USE OF A LARGER GATE WITHOUT LOSS OF GATE AESTHETICS.
- DEDICATED THERMAL CONTROLLER ALLOWS MAXIMUM CONTROL OF PROCESS.
- INVOLVING THE MOLD BUILDER, HOT RUNNER MANUFACTURER AND THE MATERIAL SUPPLIER IN THE DESIGN AND SELECTION OF HOT RUNNER SYSTEMS WILL IMPROVE PROBABILITY OF PROJECT SUCCESS.

VENTING GAS TRAPS



CRITICAL CONSTRAINTS

DEPTH: DETERMINED BY VISCOSITY OF MATERIAL.
SUGGESTED VENT DEPTHS FOR EASTMAN MATERIALS ON OPPOSITE PAGE.

NOTES

- UNVENTED GAS TRAPS MAY THERMALLY DEGRADE OR BURN THE MATERIAL.
- UNVENTED GAS TRAPS MAY REQUIRE HIGH PRESSURE TO FILL OUT PARTS OR CAUSE SHORT SHOTS.

SUGGESTED VENT DEPTHS

Material	Description	Vent Depth (inches)	Vent Depth (mm)
DN004	Copolyester	0.001-0.0012	0.025-0.30
K2000	Copolyester	0.001-0.0012	0.025-0.30
GN005	Copolyester	0.001-0.0012	0.025-0.30
Tenite 576E	Cellulose Acetate Butyrate	0.0005-0.001	0.0125-0.025
Tenite 375A	Cellulose Acetate Propionate	0.0005-0.001	0.0125-0.025
DN101	Copolyester	0.0005-0.001	0.0125-0.025
DA111	Polycarbonate/Polyester Melt Blend	0.0005-0.001	0.0125-0.025
DA105	Polycarbonate/Copolyester Melt Blend	0.0005-0.001	0.0125-0.025
DA107	Polycarbonate/Copolyester Melt Blend	0.0005-0.0015	0.0125-0.025
AG215	15% GFR Copolyester	0.0005-0.0015	0.0125-0.0375
AG230	30% GFR Copolyester	0.0005-0.0015	0.0125-0.0375
CG007	30% GFR Polyester	0.0005-0.0015	0.0125-0.0375
CG907	30% GFR Polyester	0.0005-0.0015	0.0125-0.0375

NOTES

- PARTIAL LISTING ONLY; CONTACT EASTMAN REPRESENTATIVE FOR VENT DEPTHS OF MATERIALS NOT SHOWN
- REFER TO "VENTING GAS TRAPS" FOR ADDITIONAL VENT DIMENSIONS

TOOL DESIGN CHECKLIST

MATERIAL FLOW

- **SPRUE**
  - NON-RESTRICTIVE
  - BALANCED COOLING
- **RUNNER SYSTEM**
  - COLD SLUG WELLS
  - NO SHARP CORNERS
  - GRADUAL SIZE CHANGES
  - BALANCE
- **PART**
  - NO SHARP CORNERS
  - VENTING
  - REFER PART DESIGN CHECKLIST
- **GATING**
  - NON-RESTRICTIVE
  - WELD LINE LOCATIONS

COOLING

- **SPRUE**
  - HIGH THERMAL CONDUCTIVITY
  - BALANCED COOLING
- **FLOWRATE**
  - NON RESTRICTIVE LINES
  - TURBULENT FLOWRATE (USE EASTMAN FLOWRATE PROGRAM)
- **LOCATION**
  - BALANCED (WARPAGE CONTROL)
  - CLEARANCE THROUGH TOOL (OTHER LINES, PINS, ETC.)
  - ADEQUATE FOR THICK PART WALLS

EJECTION

- **STROKE**
  - LIFTER RELEASE
  - PART EJECTION
  - DRAFT
- **DRAFT**
  - STICKING