Making Great Plastic Parts

Howard Mullin, VP of Control Plastics
YOU DETERMINE QUALITY AND PRICING WHEN YOU DESIGN THE PART.

THE PROCESSOR GETS INTO TROUBLE WHEN YOUR DESIGN DOES NOT ALLOW GOOD PROCESSING WINDOWS.
<table>
<thead>
<tr>
<th>MATERIAL CHECKLIST</th>
<th>CHEMICALS</th>
<th>APPEARANCE CHARACTERISTICS</th>
</tr>
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<tbody>
<tr>
<td>EXPLODED PART LIFE</td>
<td>DISCOURSING TEMPERATURE</td>
<td>COLOR, (Rgiment/Dye/Darkenment)</td>
</tr>
<tr>
<td>USE OF PART</td>
<td>LOAD WHEN EXPOSED</td>
<td>FINISH (SPF-2N Number/Dye/Color/Toned Textured/Textured)</td>
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<tr>
<td>ELECTRICALS</td>
<td>STRESS RELIEVING RESISTANCE</td>
<td>SIZING/TEXTURED NAME/BRUSHED/WHITE</td>
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<tr>
<td>SURFACE - VOLTAGE RESISTANCE</td>
<td>ACRID (Space/Type)</td>
<td>SURFACE UNIFORMITY</td>
</tr>
<tr>
<td>DELECTRIC STRENGTH</td>
<td>ORGANIC SOLVENTS</td>
<td>SECOND OPERATIONS</td>
</tr>
<tr>
<td>DIELECTRIC CONSTANT:</td>
<td>AVAILABLE (Space/Type)</td>
<td>DECORATING</td>
</tr>
<tr>
<td>(SOUTH)</td>
<td>SKELETON (Space/Type)</td>
<td>WOOD SPRAY ALLOWED</td>
</tr>
<tr>
<td>(MID)</td>
<td>RESISTIVITY, BODY PLASTIC</td>
<td>SKIN SCREEN</td>
</tr>
<tr>
<td>(NORTH)</td>
<td>MOISTURE (Space/Type)</td>
<td>HOT STAMP</td>
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<td>ARC RESISTANCE</td>
<td>MINERAL (Space/Type)</td>
<td>LABELS</td>
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<td>ANTI-STATIC PROPERTIES</td>
<td>DESIGNER (Space/Type)</td>
<td>PAINT</td>
</tr>
<tr>
<td>SQUEEZING</td>
<td>POTABLE WATER (Space/Type)</td>
<td>PLASTIC</td>
</tr>
<tr>
<td>ELECTRICAL GROUNDING</td>
<td>GREY WATER (Space/Type)</td>
<td>GLASS</td>
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<td>MECHANICAL</td>
<td>STERILIZED (Space/Type)</td>
<td>GLASS TRANSFER</td>
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<td>COMPRRESSIVE MODULUS</td>
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<td>HOURS UNDER LOAD</td>
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<td>TENSIILE PLASTIC MODULUS</td>
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<td>代仮設および日旋回</td>
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<tr>
<td>ELUVATION</td>
<td>CO2</td>
<td>代仮設および日旋回</td>
</tr>
<tr>
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<td>ETHYLENE OXIDE</td>
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<tr>
<td>ABRASION/STATION RESISTANCE</td>
<td>GAS</td>
<td>代仮設および日旋回</td>
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<td>OTHER</td>
<td>FOCUSING KITS</td>
</tr>
<tr>
<td>FATIGUE RESISTANCE</td>
<td>REDUCTION RESISTANCE</td>
<td>STRESS RELIEVING RESISTANCE</td>
</tr>
<tr>
<td>(No. of Cycles/Percent)</td>
<td>OUTSIDE READING &amp; PAINTING POLISH</td>
<td>CROSS UNLINK/POST MOLD ORIENTING</td>
</tr>
<tr>
<td>DECOMPOSITION</td>
<td>SPECIFIC GRAVITY (Space/Type)</td>
<td>WOULERING CONSIDERATIONS</td>
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<tr>
<td>COMPOSITION OF FORMATION</td>
<td>SPECIFIC GRAVITY (Space/Type)</td>
<td>MATERIAL EMBRACE</td>
</tr>
<tr>
<td>MOISTURE</td>
<td>RADIATION QUALITY</td>
<td>STRESS RELIEVING RESISTANCE</td>
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<tr>
<td>ENVIRONMENTAL PNOADDICITY</td>
<td>SURFACE FEEL, DRY, DUSTY, (Space/Type)</td>
<td>TOLERANCES</td>
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<tr>
<td>WATER ABSORPTION</td>
<td>HUMIDITY</td>
<td>MATERIAL SHEDDING</td>
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<tr>
<td>WATER RESISTANCE</td>
<td>MOISTURE</td>
<td>SPARKLING RANGE</td>
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<tr>
<td>HUMIDITY</td>
<td>FLAMMABILITY</td>
<td>TOLERANCES</td>
</tr>
<tr>
<td>MOISTURE</td>
<td>UL 94 CLASSIFICATION</td>
<td>BEND CURVE</td>
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<tr>
<td></td>
<td>UL HEAT DISTORTION</td>
<td>BEND CURVE</td>
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<tr>
<td></td>
<td>OUTDOOR EXPOSURE</td>
<td>BEND CURVE</td>
</tr>
<tr>
<td></td>
<td>U/V (Life)</td>
<td>BEND CURVE</td>
</tr>
<tr>
<td></td>
<td>CHEMICAL</td>
<td>BEND CURVE</td>
</tr>
</tbody>
</table>
A GREAT PLASTIC PART IS ONE THAT:

- DOES THE FUNCTION INTENDED, AT THE PRICE THAT IS NEEDED.
- LOOKS GOOD.
- MEETS TOLERANCES.
- HAS LOW INTERNAL STRESSES.
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
- FINISHING
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL

EVERY ITEM AFFECTS THE OTHERS, IT IS AN ITERATIVE PROCESS.
HOW DO WE GET THERE?

- **FUNCTION**
  - DEFINE
  - SET GOALS
  - GET INPUTS FROM: CUSTOMERS, ENGINEERING, MARKETING, SALES, FINANCE, PRODUCTION AND MAINTENANCE.

- MATERIAL TO BE USED
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
- FINISHING
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
  - WHAT ENVIRONMENT WILL THE PART WILL BE EXPOSED TO?
  - PHYSICAL REQUIREMENTS OF MATERIALS (SEE CHECKLIST)
  - METALS?
  - PLASTICS (THERMOSET OR THERMOPLASTIC)?
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
- FINISHING
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
- PROCESS TO BE USED
  - INJECTION MOLDING
  - OVERMOLD (INSERT MOLDING)
  - 2 SHOT
  - MIM (METAL INJECTION)
  - CASTINGS (URETHANE FOAM, DIP, ROTOMOLD)
  - RIM (REACTION INJECTION MOLDING)
    - VACUUM/PRESSURE FORMING, COLD FORMING
    - MACHINING, WATER JET, LASER CUTTING
    - BLOW MOLDING
    - EXJECTION
- TOOL DESIGN AND FUNCTION
- FINISHING
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
  - SEE CHECKLIST
  - TOOL LIFE AND MAINTENANCE
- FINISHING
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
- FINISHING
  - DEGATING
  - MACHINING
  - INSERTS
  - DECORATING
  - SECONDARY OPERATIONS
  - SEE CHECK LIST
- VALIDATE AND VERIFY
- END OF LIFE AND ENVIRONMENTAL
HOW DO WE GET THERE?

- FUNCTION
- MATERIAL TO BE USED
- PROCESS TO BE USED
- TOOL DESIGN AND FUNCTION
- FINISHING
- VALIDATE AND VERIFY
  - QUALITY CONTROL
  - SEE CHECKLIST
- END OF LIFE AND ENVIRONMENTAL
BE CAREFUL WHERE YOU GET YOUR INFORMATION
OPTIMIZATION EQUALS BEST COSTS
A GREAT PLASTIC PART:

- **DOES THE FUNCTION INTENDED, AT THE PRICE THAT IS NEEDED.**
  - WORKS ACCORDING TO PLAN.

- **LOOKS GOOD.**
  - MINIMAL TO NO COSMETIC FLAWS CAUSED BY THE MOLD PROCESS

- **MEETS TOLERANCES.**
  - IS EASILY MEASURED (GAGES AND FIXTURES)

- **HAS LOW INTERNAL STRESSES.**
  - LOWER IMPACT STRENGTHS
  - LOWER HEAT DISTORTION
  - LOWER CHEMICAL RESISTANCE
  - LOWER ENVIRONMENTAL STRESS CRACKING RESISTANCE
  - LOWER DIMENSIONAL STABILITY
  - WORSE LOW TEMPERATURE PROPERTIES
MAKING GREAT PLASTIC PARTS

CAUSES OF HIGH INTERNAL STRESSES – DESIGNED IN BY THE DESIGNER

- SHRINKAGE AND SINK
- RIBS
- INTERNAL CORNER RADII
- WALL TRANSITIONS
- BOSSSES
- MATERIAL ORIENTATION
  - FLOW AND CROSS FLOW
- WELD LINES
- EJECTION
THE SOLUTION TO THESE PROBLEMS IS USUALLY HIGHER INJECTION SPEEDS AND VARYING MOLD TEMPERATURES

THIS CAUSES THE HIGH INTERNAL STRESSES
CASE STUDY #1  -  Mold #PY10I, Customer: GCX

ISSUES ADDRESSED:

- GATING: Are locations OK? Can we add a dome under the gate on the inside surface?
- MOLD CONCEPT
- PARTING LINES
- EJECT SIDE
- DRAFT: Can we add 1 degree draft on the zero draft surfaces?
- UNDERCUT: Can the profile of the window be modified?
- WRONG DRAFT: Can draft be reversed on these surfaces?
- TEXTURING: Need confirmation of texture area. Draft needs to be increased for texture area.
- SINK: Can rib thickness be reduced?
- 2D DRAWING: Can tolerances be opened up?
- FLOW PATTERN
GATING: Are locations OK? Can we add a dome under the gate on the inside surface?
CASE STUDY #1 - Mold #PY101, Customer: GCX

- MOLD CONCEPT
CASE STUDY #1 - Mold #PY101, Customer: GCX

- PARTING LINES

Main parting lines are shown in blue.

Slides parting lines are shown in green.

Cavity side direction
CASE STUDY #1 - Mold #PY10I, Customer: GCX

- PARTING LINES
CASE STUDY #1 - Mold #PY101, Customer: GCX

- PARTING LINES

The slide #4 include these two windows.
The slide #4 move direction

Slide #4 parting lines

Slides parting lines
CASE STUDY #1 - Mold PY101, Customer: GCX

- EJECT SIDE

This is the eject side. The ejector marks will show on these orange surfaces.

Also we will add a big cooling insert in the core insert. The 4 steel lines of the insert will show on the part surface. Is it OK to you??
NO DRAFT: Could you add 1 degree draft on zero degree surfaces?

1. The yellow surfaces are zero draft on cavity side. Could you add 1 degree draft on them for releasing the part? (by removing material)
NO DRAFT: Could you add 1 degree draft on zero degree surfaces?
CASE STUDY #1 - Mold #PY10I, Customer: GCX

- NO DRAFT: Could you add 1 degree draft on zero degree surfaces?
UNDERCUT: Can the profile of the window be modified?
WRONG DRAFT: Can draft be reversed on these surfaces?

1. The draft of these 4 side surfaces (shown in green and blue) are toward the core side. Could you reverse the draft to form them in the cavity side?
CASE STUDY #1 - Mold #PY10I, Customer: GCX

- TEXTURING: Need confirmation of texture area. Draft needs to be increased for texture area.
CASE STUDY #1 - Mold #PY10I, Customer: GCX

- **SINK**: Can rib thickness be reduced?
2D DRAWING: Can tolerances be opened up?

1. These circled dimensions are above 12 inches, but the tolerances are only +/-0.02". Could you open them to 0.03" as in the table?

<table>
<thead>
<tr>
<th>INCH</th>
<th>TOLERANCE</th>
<th>UP TO</th>
<th>TOLERANCE</th>
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</thead>
<tbody>
<tr>
<td>1,000</td>
<td>0.0031</td>
<td>25.4</td>
<td>0.08</td>
</tr>
<tr>
<td>2,000</td>
<td>0.0041</td>
<td>59.8</td>
<td>0.12</td>
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<tr>
<td>3,000</td>
<td>0.0059</td>
<td>76.2</td>
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<tr>
<td>4,000</td>
<td>0.0083</td>
<td>104.6</td>
<td>0.21</td>
</tr>
<tr>
<td>5,000</td>
<td>0.0091</td>
<td>127</td>
<td>0.26</td>
</tr>
<tr>
<td>6,000</td>
<td>0.0118</td>
<td>152.4</td>
<td>0.30</td>
</tr>
<tr>
<td>7,000</td>
<td>0.0148</td>
<td>177.8</td>
<td>0.38</td>
</tr>
<tr>
<td>8,000</td>
<td>0.0178</td>
<td>203.2</td>
<td>0.45</td>
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<tr>
<td>9,000</td>
<td>0.0208</td>
<td>228.6</td>
<td>0.53</td>
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<tr>
<td>10,000</td>
<td>0.0238</td>
<td>254</td>
<td>0.60</td>
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<tr>
<td>11,000</td>
<td>0.0268</td>
<td>279.4</td>
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<tr>
<td>12,000</td>
<td>0.0308</td>
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FLOW PATTERN