Tool Design Review List for Plastic Injection Molds

To be covered at the preliminary tool design review and then again at the final tool design review. The IMMI Engineer and the IMMI Strategic Buyer are responsible for assuring that tool design reviews are conducted and that each item below is considered during the tool design review including the requirements document. The Supplier is responsible for participating as the tooling and processing expert. The IMMI Engineer is responsible for assuring that this document is signed off by all parties. If the tool design review is waived, all three parties must sign off, confirming agreement.

Part Number(s): _______________________
IMMI PO#: _________________________
Date of Tool Design Review: ____________________________
Preliminary / Final / Waived (circle all applicable)

IMMI Engineer: _____________________________
print name

IMMI Strategic Buyer: _____________________________
print name

Supplier Representative: _____________________________
print name

Tool Design Review Discussion Topics:

Tooling
1) See the list of requirements (ENG-0168).
2) Clamp plate thickness – What is the molder’s preference?
3) IMMI logo.
4) Is it a good idea to target a steel safe condition in select areas to allow for adjustments due to tight tolerances or warp? Warp study?
5) Full-length runner venting? special dump for runner vent?
6) Treatment of the coolant channels to prevent corrosion or rust preventative in coolant.
7) More support pillars – near center? certain locations?
8) Plating of the cavities/cores (inserts and retainers) to reduce erosion/corrosion.
9) Actions or interchangeable sections - designed for removal at the PL?
10) General function/design of tool.
11) Flash – label each potential flash location and consider the following.
   a) What is acceptable and where?
   b) What is the favorable flash direction at each flash opportunity? What is the flash direction according to the tool design at each flash opportunity? How do these two compare?
   c) Can each potential flash location (direction) be moved (changed) to produce a more forgiving situation?
12) Potential mis-match (insert lines, parting lines, etc.) - label each location and consider the following
a) Are they shown and noted for easy reference on the tool drawing?
b) Should they be noted on the part drawing and the acceptable mismatch stated?
c) How much mis-match is allowed? Where?
d) Is the location OK with respect to part function? Can insert lines be located such that they are forgiving of flash and mismatch?
e) What is the preferred step direction at mismatch locations? Which do we prefer, do we want the insert proud/recessed?

13) 3D data - issues/problems?

14) Bypassing steel -- a minimum 7-degree angle is suggested. The more the part can tolerate the better.

15) Part Design Intent to be discussed.

16) Is the tool designed to run properly at the recommended mold temp for the selected material? : Acetal, 180 F ?

17) Shrink rate: what factors are the molder/tool designer taking into consideration (mold temp, pressure, gate size, wall thickness, etc.).

18) Cavity ID, date wheel(s), PNs, and other IDs: location? above/below surface?

19) High temperature insulation sheet (board) - at least 1/4 inch thick - should be considered if the designed mold temp is above 130 F.

20) Dieseling: is this resin prone to erode/corrode steel? -special vent features to prevent dieseling- should stainless be used?

21) Cavity alignment features - are additional cavity/core alignment features a good idea? taper locks?

22) Texturing: Make sure there is a step (0.15 mm) or PL at transitions between texture and smooth? Draft: at least one degree more than min required - twice min required suggested?

23) Surface finish: polish requirements and NO polish areas.

24) What is tooled into the solid? What should be inserted?

25) Draft:
   a) Is draft needed other than what is on the IMMI data?
   b) Undrafted areas?
   c) 3 degrees on B-side, 1 degree on A-side?

26) Runner:
   a) Runner shutoffs (rotating sprue bushing)?
   b) A valve gate designed to reduce flow line creation should be considered with appearance critical parts.

27) Thermal Management.
   a) Turbulent flow through each coolant channel.
   b) Jumpers (should not use) - use manifolds on inlets and outlets.
   c) Consistent flow path when comparing cavities.
   d) Copper alloy inserts.
   e) The temperature rise from inlet to outlet should be less than 4F – will the cooling plans achieve this?
   f) Thermocouples?

28) Gating:
   a) Identical on each part.
   b) Location: Thickest section of the part? As close to the part’s center of mass (CG) as possible? Best location for fill? Best location to reduce warp? Fill study?
   c) Is it a sub-gate or tunnel gate into the A-side? If so, how will part/runner be kept on the B-side?
   d) Inserted for easy replacement/repair? Is a witness line at the insert acceptable? What is acceptable flash at the insert line? How much vestige is acceptable?
   e) Is there an ejector at the gate? One on the part and one on the runner?
   f) Should there be a special geometry at the gate? Recess to help tolerate vestige?
   g) Appearance near the gate: Is blush acceptable?
   h) Gate dimensions.

29) Ejectors.
   a) More is usually better - are you certain there is enough circumference to prevent stretch marks or poke.
   b) Acceptable flash at each ejector.
   c) Ejector sizes and locations.
   d) Where are ejectors problematic (favorable / unfavorable places for ejectors).
   e) IMMI Engineering must approve all.
   f) Notes on tool drawing to lap in the ejectors, if applicable.
   g) Special geometry around the ejectors.
h) Ejector plate pull back plugs to allow easy attachment of the press’s push rods to the ejector plate.
i) Pressure sensor behind ejector(s)?

30) Should a tool heater be used?

Production
31) Sink: What is acceptable and where?
32) Knit lines: Where are they likely? What is acceptable and where? Is visual OK? Is a ditch (geometry) at knit line OK - how deep?
33) Secondary operations?
34) Planned molding parameters? Does the molder plan to follow the resin manufacturer’s suggestions?
35) What are the resin drying plans. What equipment? The molder should have a moisture analyzer.
36) What is the planned barrel volume?
37) What is the planned press size? Age?
38) Machine tonnage compared to part surface area times # of cavities?
39) Regrind: how much is acceptable? What is shot volume? What is sprue and runner volume? What is ratio?
40) Inspections:
   a) What will be the size of the unapproved buffer between approval inspections?
   b) How does the molder assure that only conforming parts from the buffer get mixed in with approved production?

Other
41) Top three expected difficulties in tool manufacture - what can be done to improve the situation?
42) Top three expected difficulties in tool maintenance - what can be done to improve the situation?
43) Top three expected difficulties in molding parts - what can be done to improve the situation?
44) IMMI procedures QA-33, QA-38, QA-51, PUR-02, or PUR-03.
45) A level 4 PPAP, including a validation layout and capability studies, may be required annually. Characteristics to be checked include: KCs and dimensions with a statistical requirement. Data from the most recent in-process checks may be used.
46) Expected tool life and perpetual maintenance?

Review of Part and Part Drawing
47) Default Tolerances: Block tolerances? Equation? \[ T = \text{tolerance} = +-(A + B*Z) \], \( Z = \text{feature size} \), \( T_{\text{max}} = 0.xx \) mm.
48) Review measurement methods: KCs, other dims.
49) Special fixturing /gaging for measurement of the parts.

PPAP Approval
50) It is the supplier’s responsibility to prove to IMMI that the tooling is capable of consistently making parts that meet the applicable requirements.
51) How will measurements on the edge of a dimensional allowance be handled (drawing change or tool change)?
52) PPAP Submission (what is included and requirements):
   a) Level? What components if a level four?
   b) Warrant.
   c) One full shot with runner.
   d) Measurement(s) of the gate size(s).
   e) Short shot analysis with samples and associated process parameters.
   f) Hold/pressure - time study - and associated process parameters.
   g) Actual process parameter values used for PPAP samples: pressure in Psi or similar units not percentage.
   i) Production capacity.
   j) Any test results required on the drawing.
   k) No release agents (sprays, etc.) may have been used to process the PPAP/ISIR samples.
   l) Certification for the material used to produce the samples.
   m) Total Number of Samples: 103 per cavity.
      i) Must contain the percent of regrind planned for production parts.
      ii) Processing must be identical to that planned for production parts.
n) ISIR - 3 parts per cavity - all dims including basics and reference and all GDT tolerances.
o) Control Plan.
i) Number of samples per cavity?
ii) Frequency of checks?
iii) What are the statistical requirements for in process checks?
iv) What part features will be included?
v) What processing parameters will be in the CP? It should contain a max tolerance on injection time of \(+/-0.04 \text{ seconds.}\)
vi) Will part mass be checked in-process?
vii) What will be the in-process controls on drying time, temp, humidity, dew point, and moisture content?
p) Process FMEA.
q) Tool PM plan.
i) Frequency of measuring the PL locks and the replacement guidelines (sizes).
ii) Frequency of measuring the leader pins/bushings and the replacement guidelines (sizes).
iii) Is the PM plan reactive or proactive?
r) Process Flow Diagram.
i) Include running into an “unapproved” parts container prior to checks (buffer).
ii) Include drying if resin gets dried.
iii) Include tool heater if used?
s) Capability Studies.
i) 30 pieces?
ii) Number of setups (tool settings)?
iii) All key characteristics and as indicated on the drawing.
iv) All KCs and others as indicated on drawing and those with a statistical requirement. (mass?).
v) Ppk \(\geq 2.0\) - Each cavity.
vi) Cpm \(\geq 0.63\) - Each cavity.
vii) What must be calculated: Ppk, Cpk, Pp, Cp, Cpm, sample SD, Cpm SD, average, range, max, min?
viii) Appearance Requirements: visible knit lines, visible cold flow lines, sink.
ix) Flash requirements.
t) Processing:
i) Comparison of the calculated residence time and the manufacturer’s suggested limit.
iii) Barrel volume. Shot to Barrel Volume percentage.
iv) PPAP should include proof that the temperature rise from inlet to outlet is less than 4F.
u) What else needs to be included in PPAP to help make this part DTS?

IMMI Engineer: _____________________________
signature

IMMI Strategic Buyer: _____________________________
signature

Supplier Representative: _____________________________
signature