

Failure Analysis of Injection Molded Plastic Parts

Course Overview

An injection molded plastic part typically goes through these product life cycle stages: design, tooling, molding, assembly, and customer usage.

Failures can originate from the CAD designer, the designer of the injection molding tool, and the molder.

- a. A toolmaker/molder that receives CAD files and is unaware of built-in failures in the CAD files will lock in those failures if the toolmaker proceeds with cutting tool steel. DFM reviews by the toolmaker/molder typically cannot detect built-in problems like creep failures, fatigue failures, and moisture related failures.
- b. An inadequate tool design can lead to warpage failures. Molded parts then don't fit their intended assemblies.
- c. A non-diligent molder overlooks critical resin preparation processes, leading to brittle parts and cosmetic failures that seem to come and go with weather changes.

These failures typically escape to the assembly stage and customer usage stage, where the maximum damage is inflicted when production is stopped. Rework, scrap, recalls, equally defective replacement parts, etc. are the repercussions that lose money for the companies. This course addresses how those failures can be identified and prevented.

Course Objectives

1. Learn how built-in failures in the CAD files can be identified and eliminated before cutting tool steel.
2. When a plastic part has nevertheless failed, be able to quickly identify the root-cause, solve the issue, and resume production.
3. Warpage can be quite easily reduced with proper techniques.
4. Understand the criticalness of resin preparation in the molding process.
5. Lack of nonlinear FEA simulation produces inaccurate results for structural parts.
6. Include creep and fatigue failures in the DFM checklist.

The uniqueness of this course

This two-day course is not about adjusting injection molding parameters.

This course looks into the more serious failures attributed to oversights by the CAD designer, the toolmaker, and the molder.

1. Oversights by the CAD designer include: designs that are not toolable, not manufactureable, not considering nonlinear behavior of plastics in structural calculations; not considering that plastics do not behave like metals; omitting nonlinear FEA simulation; inability to detect wrong FEA boundary conditions and wrong results.
2. Oversights by the toolmaker include: uneven cooling of the tool, leading to warpage of the molded parts.
3. Oversights by the molder include: wrong drying equipment for the resins; inadequate drying processes/controls; lack of moisture measurement; outsourced moisture

measurement; wrong use of moisture analyzers; not using the dried resins promptly; overheating; residence time.

Real case studies will be presented to demonstrate how failures could have been avoided if the CAD designer, the toolmaker, and the molder had each exercised their due diligence.

Who should attend

1. Target groups are: R&D engineers, NPI engineers, tool designers, molders, Project Management, Process Improvement Manufacturing, Production / Supplier Quality, Procurement, Senior Management.
2. Target Industries are: Tool makers, Molders, Consumer goods, Automotive, Electronics Packaging, Medical, Furniture, EMS (Electronic Manufacturing Services).

Key topics

Day 1

1. Sink marks
2. Drag marks
3. Blush
4. Streaks
5. Warpage (+ Case Study)
6. Voids
7. Moisture
8. Processing faults
9. Break at weld lines

Day 2

10. Poor materials knowledge (+ Case Study)
11. Fail due to bad FEA (+ Case Study)
12. Broken snap-fits
13. Rupture press-fits
14. Creep & Stress relaxation (+ Case Study)
15. Fatigue (+ Case Study)

Methodology

Lecture notes, video clips, discussions, case studies, spot questions, pre- and post-questionnaire.

Course duration

Two days.

Prerequisite

Some basic knowledge of how plastic parts are designed, how injection molding tools are designed, and the injection molding process.

Certification

A certificate of attendance will be issued to those who fulfill 80% attendance.

Testimonials

1. *One of a kind. Very accurate and meets the objective. Instructor is very knowledgeable and subject matter expert. Mind blowing.*
 - *Muhammad Shuhail Hassan, R&D Manager, Leibherr Appliances.*
2. *Very knowledgeable and knows what is happening in the industry currently.*
 - *Adam Shazni bin Rosni, Sony R&D.*
3. *Interesting new knowledge about plastic characteristics and how to avoid bad design.*
 - *Mohd Shafice bin Sidek, Sony R&D.*
4. *Very good explanation and very important for development stage of a product.*
 - *Mohd Nor Fikri bin Jamaludin, Product & Process Asst Engineer, Allied Hori.*
5. *Good! Many examples (with actual samples in real cases) have been given.*
 - *Khairul Azhar, Design Engineer, MK Electric.*
6. *Very knowledgeable instructor and able to share/provide practical suggestion/solution to problem being raised.*
 - *Goh Sheng Sze, Head of Global Product Development Center, MK Electric.*