



## Kruse Training Cause-and-Effect Seminar

### 2-Day Seminar Outline

*Welcome to Kruse Training's Circle of Knowledge Seminar – a program focused on the “cause and effect” of injection molding. Our aim is to help develop synergistic teams of cross-trained professionals who can successfully design and mold plastic components.*

## DAY ONE

### Lesson 1: Molding Fundamentals: Inside the Mold

Having the foundational understanding of what happens inside a mold during the injection molding process is key for a successful career in the plastics industry. From part designers to mold designers to process engineers, having a good grasp of these molding fundamentals is essential to designing and produce high quality parts.

- Learn the fundamentals of what goes on inside a mold during the injection molding process
- Get a basic understanding of how a molding machine functions and its various components
- Analyze real-life molded parts and learn the cause and effect behaviors of design and process

### Topics include:

- The Molding Machine
- Temperature & Fill Speed
- Wall Thickness & Injection Pressure
- Switch-Over from Filling to Packing
- Packing Behavior
- Cooling Behavior
- Warpage Due to Differential Shrinkage
- Warpage Due to Differential Cooling
- Warpage Due to Fiber Orientation
- Cooling Behavior

## Lesson 2: Polymer Materials: Material Behavior

It is important for part and mold designers not only to understand design principles, but also to understand the fundamentals of plastics. The choice of a plastic, or polymer, has a strong impact on the outcome of a molded part. Having a general understanding of the basic properties and structures of polymers will help part and mold designers, as well as processors, make choices and decisions that will optimize the final part.

- Learn the fundamentals of polymer material characteristics and basic polymer categorizations
- Get a basic understanding of how different material behaviors will impact the molding process and the final molded part
- Analyze real-life molded parts and learn the cause and effect behaviors of design and process

### Topics include:

- Polymer Materials
- Viscosity
- PVT
- Thermal Properties
- Mechanical Properties
- Deformation Behavior

## Lesson 3: Part Design:

As plastic part assemblies become more sophisticated, individual part designs becomes more complex. This complexity can create challenges for part designers, as well as for mold designers and process engineers. Early in the part design phase, designers must establish design parameters, a necessary step for molding high-quality parts that meet specifications and expectations.

- Learn the basics of part design and how various design elements impact a molded part
- Learn how to optimize different design elements to achieve high quality molded parts
- Analyze real-life simulations and learn to determine optimal outcomes

### Topics include:

- Nominal Wall Thickness
- Flow Leaders
- Flow Restrictors
- Rib Thickness
- Rib Height
- Rib Structure
- Corrugations & V-Grooves
- Bosses
- Gussets
- Rib Structure

## Lesson 4: Mold Design: Gates

Gate design and placement are key factors in mold design. Types of gates, placement, and size significantly affect the outcome of molded part so should be understood for maximum benefit. Placement options for gates are often limited by design restrictions and other part-related constraints, understanding and utilizing industry best practices are useful in achieving optimal results.

- Learn the basics of mold design and how various design elements impact a molded part
- Gain an understanding of various gate styles and how they influence the molding process
- Analyze real-life simulations and learn to determine optimal outcomes

### Topics include:

- Cold Sprue
- Pin-Point Gates
- Round & Oval Dual Sub-Gates
- Round & Oval Six Gate Sub-Gates
- Ejector Pin Sub-Gates
- Edge Lapped Chisel Gates
- Fan Gates
- Film Gates
- Disk Gates
- Ring Gates
- Cashew Gates
- Symmetry and Balance

## Lesson 5: Mold Design: Cold Runners

Cold runner systems are an important aspect of mold design. By optimizing cold runner shapes and sizes, important molding processes such as pressure drops, polymer shearing, packing and cooling behavior, gate sealing time, and overall cycle time can be made more efficient as well.

- Learn the basics of mold design and how various design elements impact a molded part
- Gain an understanding of cold runners and how they influence the molding process
- Analyze real-life simulations and learn to determine optimal outcomes

### Topics include:

- Types & Design
- Runner Patterns
- Optimizing Cold Runner Sizes
- Artificially Balancing a Cold Runner
- Balancing Multi-Gated Runner Parts
- Balancing Family Molds

## Lesson 6: Mold Design: Cooling

Injection molding is a process of heat exchange – the heat that goes into a mold must also be removed. Understanding the thermal behavior of polymers and the pathway of heat inside a mold is important for designing and processing a successful molding project.

- Learn why the cooling phase of a molding cycle is the logical phase to optimize
- Gain an understanding of the various type of cooling options to remove heat from a mold
- Analyze real-life simulations and learn to determine optimal outcomes

### Topics include:

- Cooling Systems Overview
- Temperature Behavior in Molds
- Parallel and Serial Coolant Circuits
- Dimensioning and Positioning Cooling Lines
- Baffles and Bubbler Circuits
- Mold Steel Selection
- Thermal Pins

# DAY TWO

## Lesson 7: Processing: Filling Phase

Molding high-quality parts is dependent on many factors, including skillful part and mold design, an understanding of polymer material behavior, and an optimized process. It is important for injection molding processing engineers to follow key steps to ensure consistently high-quality molded parts.

- Learn the fundamentals of process optimizing by analyzing the filling phase of molding a part
- Gain an understanding of how part design, mold design, and process are connected and interdependent
- Analyze real-life molded parts and learn the cause and effect behaviors of design and process

### Topics include:

- Nozzle Tip Designs & Injection Pressure
- Pressure Behavior
- Temperature Behavior
- Optimizing the Fill Speed
- Fill Speed Profiles

## Lesson 8: Processing: Packing and Cooling Phase

Molding high-quality parts is dependent on many factors, including skillful part and mold design, an understanding of polymer material behavior, and an optimized process. It is important for injection molding processing engineers to follow key steps to ensure consistently high-quality molded parts

- Learn the fundamentals of process optimization by analyzing the packing and cooling phase of molding a part
- Gain an understanding of how part design, mold design, and process are connected and interdependent
- Analyze real-life molded parts and learn the cause and effect behaviors of design and process

### Topics include:

- Packing Pressure Profiles: Amorphous
- Packing Pressure Profile: Semi-Crystalline
- Wall Thickness & Packing Pressure
- Polymer Flow During Packing
- Gate Seal Time
- Clamp Tonnage

## Lesson 9: Processing: Shrinkage and Warpage

Molding high-quality parts is dependent on many factors, including skillful part and mold design, an understanding of polymer material behavior, and an optimized process. It is important for injection molding processing engineers to follow key steps to ensure consistently high-quality molded parts.

- Learn the fundamentals of shrinkage and warpage during the processing phase of injection molding
- Gain an understanding of how part design, mold design, and process are connected and interdependent
- Analyze real-life molded parts and learn the cause and effect behaviors of design and process

### Topics include:

Shrinkage & Warpage

Flow-Induced Molded-In Stress

Thermally-Induced Molded-In Stress

- Amorphous & Semi-Crystalline Materials

- Fiber-Filled Materials

- Fiber Percentage

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The “Circle of Knowledge” program is 2-day in-person seminar based on the Kruse Training online training solution. The seminar is a comprehensive cross-training initiative for part designers, mold designers, and process engineers.

Upon completion of the seminar, participants receive a 3-month single-user account with unlimited access to <https://krusetraining.com>. During this trial period users who complete Level 1 lessons with passing quiz scores will receive certification from Kruse Training. After the trial period, participants may choose to sign up for continued access to the online program for more advanced training as it becomes available.

For additional information, seminar pricing, or other questions, contact Torsten Kruse at 239-351-7428 or [torsten\\_kruse@krusetraining.com](mailto:torsten_kruse@krusetraining.com).

PROGRAM DEVELOPMENT IN PROGRESS/AVAILABLE IN 2022:

## **Kruse Training “Molding Defects” Seminar**

*The Kruse Training “Molding Defects” seminar will be a program focused on common molding defects and techniques for minimizing or eliminating them. Featured lessons will include the following topics:*

- Short Shots
- Flash
- Meld and Weldlines
- Sink Marks
- Voids
- Gate Blush
- Burn Marks
- Air Entrapment
- Jetting
- Craze and Cracks
- Splay
- Tiger Stripes and Record Grooves
- Ejection / Scuff Marks and Scratches
- Part Deformation during Ejection
- A- or B-Half Part Sticking

For additional information, seminar pricing, or other questions, contact Torsten Kruse at 239-351-7428 or [torsten.kruse@krusetraining.com](mailto:torsten.kruse@krusetraining.com).