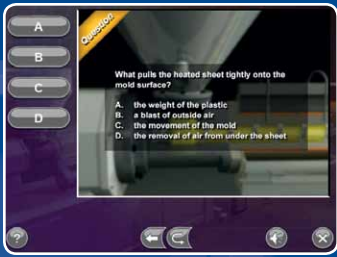


# Thin Sheet Thermoforming



Paulson's fully interactive training programs explain the relationship between machine controls, plastic behavior and the thermoforming process with full motion video, text, audio and crisp, dynamic graphic animation.

Thermoforming is one of the most common processes for making a wide variety of consumer and industrial plastic parts. It's also one of the fastest growing of the plastics manufacturing industries and employs thousands of personnel. While simple in concept, thermoforming is a complex process requiring knowledgeable and skilled personnel at all levels in the plant.

Through these six lessons, your personnel will learn the fundamentals of the thermoforming process, how to quickly solve problems and will develop advanced troubleshooting skills. You'll receive complete training on all aspects of day-to-day thermoforming production. This training course:

- ◆ Shows and describes each step in the thermoforming process using actual in-plant footage and high definition 3D animation.
- ◆ Describes the behavior of the molten plastic and its effects on part properties.
- ◆ Explains the effects on the formed parts of each step in the process: heating, forming, and trimming.
- ◆ Covers extrusion and sheet extrusion fundamentals.
- ◆ Teaches how to optimize control settings, safety around the thermoforming machinery and thermoforming for maximum efficiency and profit.

Recommended For: Machine Operators, Setup Personnel, Process Technicians, Maintenance Technicians, Process Engineers, Project Engineers

## Thin Sheet Thermoforming

### 1 Lesson

#### The Machinery and Plastic Behavior

In this section of the course, personnel will learn how to control sheet temperature—one of the most important factors in achieving and maintaining part quality. Plastics are unique materials that have their own unique properties. Well-regulated control of plastic temperatures will minimize plastic degradation, contribute to part thickness uniformity, and improve overall quality.

### 2 Lesson

#### Thermoforming Process - Plastic Materials and Properties

This section explains many of the forming methods used to develop specific part properties, with emphasis on looking inside the forming process to see what happens to the plastic. For tooling personnel, it's important they understand the effects of each type of forming and type of mold on the formed parts.

### 3 Lesson

#### Pre-Heating and Heating the Plastic

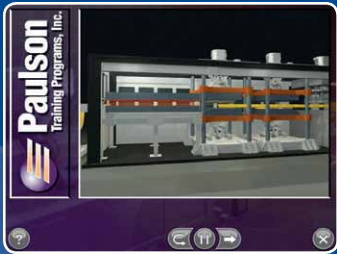
In the thermoforming process, the plastic is heated twice—once in the extruder and once in the thermoforming machine. This lesson covers the 3 main heating methods used in the thermoforming machine—conduction, convection and infrared. Control of the heating in the thermoformer is a key to good part quality. Explains how plastic absorbs heat and how that affects the thermoforming process. Expands on the infrared heating of the plastic sheet including emissivity, view factor, wavelength and absorption.

### 4 Lesson

#### Transport of Plastic Sheet through the Thermoforming Line

This lesson covers heater temperature control methods in the heating tunnel, the transport system through the thermoforming line, indexing, sheet clamping methods, mold venting, plug assist and drape assist forming and pressure forming.





## 5

### Lesson

#### **Mold Design, Machine Controls, Forming and Cooling the Parts**

This lesson explains the common types of molds used in thermoforming along with good and bad cooling design layouts. Mold cooling design, cooling methods and the importance of accurate and consistent hook-ups are emphasized. Also included is a chart of cooling time estimates. Teaches the effects of part cooling and cooling rate on short and long-term part shrinkage. How cooling and cooling changes affects part properties, particularly part stress is explained in detail. A section on the effects and use of the vacuum controls is also included. The amount of vacuum, the vacuum rate (vacuum bleed) and vacuum timing is also presented. This is important because each of these factors affects the sheet distribution.

## 6

### Lesson

#### **Part Trimming and Finished Part Properties**

Thermoformed parts must be accurately trimmed. This lesson moves to the final thermoforming step, trimming. The types of trimming, both knife-like and shear trimming (matched metal) are shown and explained. The lesson also covers tabbing and shimming. An analysis of the structure of the formed part properties explains the effects of heating, forming and cooling on the finished part properties. It is the internal structure and distribution of the plastic in the part that ultimately determines if the thermoformed parts will meet customer specifications. The lesson concludes with a recommended start-up procedure that will limit internal stresses.

## PAULSON'S INTERACTIVE LEARNING SYSTEM



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