Morgan Lens Assembly – Partial Automation

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Special thanks to our advisor Patty Buchanan, and our industry sponsor Steve Bixby

Index of Performance

- **$400-800** savings in production costs per lot
- **13-23%** reduction in waste
- **12 hour** reduction in setup time per lot
- **20%** reduction in rejection rate

Current State

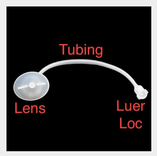
Background

Morgan Lens Product

- Developed in the late 1960's
- Used for eye irrigation and treatment
- Supplied in around 90% of hospitals in the US and 20 countries globally

Production Steps

1. **Assembly**
   - Fitting together the three parts of the lens (lens, tubing, luer loc)
2. **Sealing**
   - Heat sealing assembled units into their individual packages
3. **Inspecting**
   - Checking for empty packaging, defects, assembly mistakes
4. **Boxing**
   - Placing batch of assembled packaged units into storage box
5. **Stamping**



Problems

Assembly:
Variability in manufacturing processes which creates **inconsistency** in the product and adds **unnecessary processes**

Inspection:
Human subjectivity which results in an **increase in production costs**

Goals

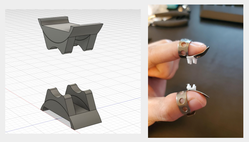
A new methodology to improve manufacturing processes and formalize quality control for the production of the Morgan Lens.

Process Improvement Design

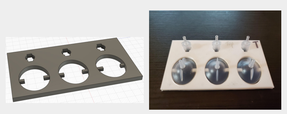
Assembly

- **Current method:** 'Homemade' finger cots

- **Goals:**
  - Reduces operator fatigue
  - Increases handling efficiency
- **Solution:** more ergonomic and efficient assembly method

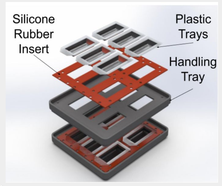


Components
1. Luer loc
2. Tube
3. Lens



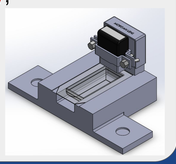
Handling Trays

- **Current method:** Assembled lenses stored in plastic bin then manually placed in sealer
- **Goals**: reduces double handling, inspection steps, and time
- **Solution:** use cart and handling trays to put assembled lenses in packaging, make transfer between processes quicker, and for storage
- **Implementation:** use at assembly table and sealer for organization and quick placement into sealer 6 at a time



Stamping

- **Current method:** manually stamp FDA required expiration date by estimating correct location; rework defective stamped units
- **Goals**: reduces inconsistency, subjectivity, and costs
- **Solution:** using a stamping jig to quickly align and stamp units; using labels to relabel rejected units
- **Implementation:** use to stamp all units

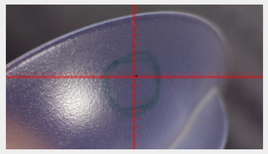


Rejection Criteria Checklist

- **Current method:** operators memorize rejection criteria
- **Goals:** reduces inconsistency and subjectivity
- **Solution:** Checklist of criteria for a defective component based on the standard operating procedure
- **Implementation:** place checklist on assembly table for easy access

Camera

- **Current method:** defect assessment with naked eye
- **Goals**: reduces inconsistency, subjectivity, and costs
- **Solution:** using a camera system to magnify and compare defects to a calibrated scale
- **Implementation:** use at assembly table only to verify suspected defects
- **Preliminary test:** confusion matrix
  - 20% of rejects are not actually rejects
  - Result shows operator's over-critical assessment



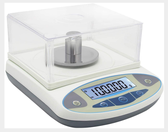
Black Spot less than 0.5mm compared to calibrated scale

	Predicted: Positive	Predicted: Negative
Actual: Positive	12	0
Actual: Negative	3	9
	15	9

Confusion Matrix
(Actual: Camera, Positive: Defect)

Scale Check

- **Current method:** manually check for presence of device with naked eye
- **Goals:** eliminates shipping empty packages
- **Solution:** using a scale to confirm existence of a device inside a package
  - A package is accepted if scale reads > 9 grams
- **Implementation**: use checkweigher to automatically reject empty packages



Result/Impact

Production

- **Assembly**
  - Promising initial tests but more long-term testing needed
- **Handling Trays**
  - Reduction in over-handling of assembled lenses
  - Reduction in necessary inspection steps caused by additional handling
  - 12 hour reduction in setup time per lot
- **Stamping**
  - Reduction in subjectivity of stamp location
  - Decrease in rejected units by 3%
  - Savings of $1 per unit or $200-400 per lot

Inspection

- **Rejection Criteria Checklist**
  - Increase in inspection consistency
  - Increase in effectiveness of training
- **Camera**
  - Increase in consistency without sacrificing speed
  - Reduction in subjectivity within quality inspection
  - Reduction in rejection rate by 20%
  - Increase in effectiveness of training
- **Scale Check**
  - Implementing a mistake proofing device (poka-yoke)
  - Facilitation of empty package
  - Prevent loss of goodwill

Further Research

- **Assembly**
  - Explore new designs & materials
- **Handling trays**
  - Critical WIP calculation & simulation to determine optimal batch size
- **Stamping**
  - Investigate the use of permanent ink on plastic for more cost-effective mistake facilitation
- **Checklist**
  - Digitize checklist to reduce clutter & focus on 5S
- **Camera**
  - Automated quality inspection prior to assembly
- **Scale check**
  - Fully-automated detection method