

# Reducing Assembly Risk Through PPAP Process Controls and Visual Identification

How GSE identified and eliminated a critical component misidentification risk through layered mistake-proofing



# Overview

A client engaged GSE to support a Production Part Approval Process (PPAP) for a large-scale new project. The scope included development and review of key quality documentation such as control plans, risk assessments, DFMEA (Design Failure Mode and Effects Analysis), PFMEA (Process Failure Mode and Effects Analysis), routing, and assembly documentation.

During the review, GSE identified a critical risk involving component misidentification that could lead to catastrophic device failure and potential end-user injury.



# The Challenge

During sub-assembly and final assembly review, it became clear that a series of six unique components could potentially be installed in multiple locations if not tightly controlled. These parts were visually very similar, the only distinguishing feature was length. In some cases, component lengths differed by as little as 0.030 inches, making them difficult to distinguish by sight alone.

# 0.030

## Length Difference

Smallest difference in component lengths, leading to high risk of misidentification.

Because these parts could be misidentified during fabrication and assembly, the risk extended far beyond the final assembly stage. If an incorrect component was labeled, stored, picked, or installed, the result could be a serious product failure. Once assembled, the only visible identifier was the end of the component, making early-stage control critical.

# Our Assessment

## Control Strategy Requirements

As the PFMEA was developed, GSE determined that the control strategy had to begin at fabrication and continue consistently through inventory handling, work order routing, assembly, and quality verification. The solution had to be simple, highly visual, scalable, and easy for operators to use without adding unnecessary complexity.

## Alternative Identification Methods Considered

Alternative identification methods such as laser marking and stamping were considered. However, because the identification area was small, those methods still carried risk of being difficult to read or misinterpreted, especially in a production environment.

# The Solution

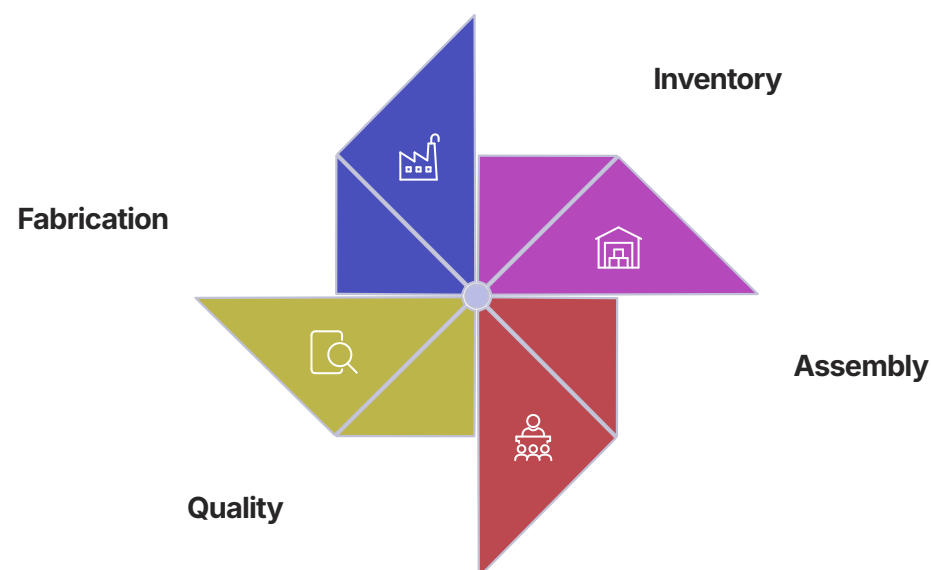
GSE developed a carrier tray system designed to fit standard inventory totes. These trays securely held each component in the length dimension, allowing the part to be identified by correct fit in the proper tray position, creating a built-in physical verification method.

**Carrier Tray System:** These 3D-printed trays were specifically designed to securely hold each component, providing a built-in physical verification method and eliminating misidentification risk.

To strengthen the control method, the trays were 3D printed in specific colors to align with a color code system applied to the end of each component. That same color code was carried through:

- Assembly work instructions
- Fabrication routing information
- Work order routing materials
- Quality control processes

This created a consistent visual identification system from fabrication through final assembly. The trays were also optimized for standard tote sizes and designed to be stackable, allowing different tote depths to be used depending on order quantities.



This diagram illustrates how the consistent color-code system was integrated into every stage, from initial fabrication to final quality control, ensuring accurate identification throughout the manufacturing process.



# Results & Business Impact

The final system greatly reduced the risk of part mix-ups during fabrication, handling, and assembly. By combining physical fit control with a simple visual color-matching system, GSE created a robust yet operator-friendly method for distinguishing components that were nearly identical in size.



## Improved Safety

Significantly reduced the likelihood of incorrect assembly, preventing catastrophic product failure.



## Stronger Quality Assurance

Enhanced traceability and error prevention across manufacturing and quality workflows.



## PPAP Approval Path

Provided a reliable path to PPAP approval, supported by robust documentation and controls.

The solution improved traceability, supported PPAP documentation requirements, and strengthened error prevention across manufacturing and quality workflows. Most importantly, it significantly reduced the likelihood of incorrect assembly that could have resulted in catastrophic product failure.

This project demonstrated the value of integrating quality planning with practical manufacturing controls. Rather than relying on markings that could be missed or misread, GSE developed a layered mistake-proofing system that was simple, repeatable, and effective. The result was a safer assembly process, stronger quality assurance, and a more reliable path to PPAP approval for a high-risk product.

# Key Outcomes



Supported a major PPAP initiative for a large-scale new project



Developed controls tied to DFMEA, PFMEA, control plans, and routing documentation



Identified a high-risk assembly issue with potential for catastrophic failure and end-user injury



Addressed six unique components with dimensional differences as small as 0.030 in.



Designed a 3D-printed carrier tray system for standard inventory totes



Implemented a color-coded identification system across fabrication, assembly, routing, and quality



Created stackable trays to support varying order quantities and tote depths



Reduced potential for mislabeling, mis-picking, and incorrect assembly



# Closing Statement

By combining PPAP quality planning with practical manufacturing controls, GSE transformed a high-risk identification problem into a simple and effective error-proofing system. The result was improved safety, stronger process consistency, and a more reliable manufacturing workflow from fabrication through final assembly.