



# Case Study

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## Sortation Module Diverter Arm Connector Sleeve Improvement

How precision machining solved a tiny misalignment causing big trouble in sortation modules



Problem



Analysis



Solution



Results



# The Problem

## European OEM Context

A mid-sized European OEM specializing in modular sortation and conveyor systems faced a persistent operational challenge during high-speed parcel sorting operations.



**The Challenge:** Diverter arms were frequently misaligning during high-speed parcel sorting operations, despite appearing to be minor issues initially.

## Cumulative Operational Impacts



### Line Stoppages

Frequent halts during peak sorting periods



### Maintenance

Increased frequency of system checks



### Lost Uptime

Reduced throughput and productivity



### Client Complaints

Downstream customers reporting issues

# Root Cause Analysis

## Stainless Steel Connector Sleeve



Used to couple drive shaft with pivoting arm

**i Key Insight:** Not a design flaw in principle, but real-world dynamics exposed a subtle weakness in execution.

## Observed Weaknesses



### Insufficient Concentricity Tolerance

Inner bore with poor concentricity tolerance led to rotational misalignment during operation.



### Sharp Step Transitions

Created localized stress points and reduced fatigue strength at transition points.



### Progressive Vibration Shift

Sleeve gradually lost positional accuracy due to cumulative vibration over time.

**Q** Review of drawings and operational conditions revealed these weaknesses were not addressed in the original design.

# Manufacturing Solution

Working from the OEM's updated drawings, we implemented comprehensive improvements:



## Enhanced Material

316L stainless steel for **higher vibration fatigue resistance**



## Stress Reduction

**Multi-radius chamfer transitions** minimize stress concentration



## Precision Machining

**One-pass mill-turn machining** ensures full coaxial integrity



## Tolerance Control

Internal/external diameters within  **$\pm 0.01$  mm**

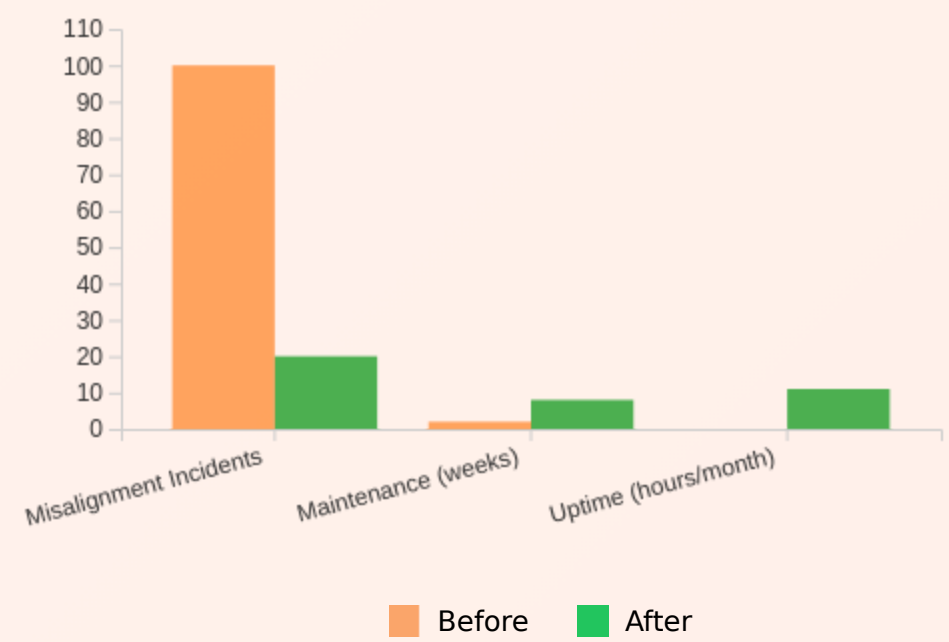


**Result:** Fully deburred, assembly-ready delivery — no additional preparation required

# Measured Improvements

After implementation of the improved connector sleeve on the OEM's pilot production line, we achieved significant and measurable improvements in operational performance:

## Before vs After Implementation



### Misalignment Incidents

Reduced by approximately **80%** within the first quarter



### Maintenance Intervals

Extended from **every 2 weeks** to **every 2+ months**



### Recovered Uptime

Operations manager reported **10-12 hours/month** of recovered uptime






### End-Client Feedback

Parcel pathing complaints **significantly decreased**

# Validation & Reliability





## Machining Setup & Tolerance Control

-  Mill-turn machining in a **single clamping** operation
-  **100%** CMM inspection for concentricity  $\leq 0.01$  mm
-  Surface roughness verified to Ra  $\leq 0.8$   $\mu\text{m}$






## Accelerated Reliability Testing

-  **500 hours** at 1.5× nominal operating speed
-  Results: **No fatigue cracks**, no measurable drift




**Test confirmed design reliability under extreme conditions**



## Field Validation (18 months)

-  Misalignment events reduced by **~80%**
-  Maintenance intervals maintained at **2+** months
-  Overall uptime improved by **7-8%** in sustained operation

## Key Validation Achievements

-  Production validation confirmed reliability in real-world conditions
-  Long-term performance maintained over 18 months
-  Comprehensive testing verified solution effectiveness

# Have a Similar Issue?

## Common Challenges We Solve



### Unexplained Drift

Misalignment in moving modules



### Loosening Components

Sleeves, housings, or bushings



### Excessive Wear

Faster-than-expected deterioration

“ We'd be glad to review your drawings and share examples of how small adjustments can bring measurable reliability gains.

## Consult With Us

Our engineering team can help identify solutions through:



### Design Review

Optimize structural design



### Tolerance Analysis

Identify critical dimensions



### Machining Control

Strict quality verification

[Request a Consultation →](#)

No obligation. Expert advice only.