

Mistake Proofing

(Poka Yoke and Error Proofing)

Outline

- What is Mistake Proofing?
- Everyday Examples
- Effectiveness
- Error Proofing and SPC
- Inspection Techniques
- Types of Poka Yokes

What is Mistake Proofing?

- The use of process or design features to prevent errors or their negative impact.
- Also known as ***Poka yoke***, Japanese slang for “avoiding inadvertent errors” which was formalized by Shigeo Shingo.
- Inexpensive.
- Very effective.
- Based on simplicity and ingenuity.

Everyday Examples

3.5 inch diskettes cannot be inserted unless diskette is oriented correctly. This is as far as a disk can be inserted upside-down. The beveled corner of the diskette along with the fact that the diskette is not square, prohibit incorrect orientation.



Fueling area of car has three error-proofing devices:

1. insert keeps leaded-fuel nozzle from being inserted
2. tether does not allow loss of gas cap
3. gas cap has ratchet to signal proper tightness and prevent overtightening.



New lawn mowers are required to have a safety bar on the handle that must be pulled back in order to start the engine. If you let go of the safety bar, the mower blade stops in 3 seconds or less.



Evidence of the Effectiveness

- **AT&T Power Systems** is first US manufacturer to win the Deming prize. Average outgoing defects reduced by 70%.
- A washing machine drain pipe assembly line produced 180,000 units without a single defect (6 months).
- **TRW** reduced customer PPM's from 288 to 2.
- **Federal Mogul:** 99.6% less customer defects and 60% productivity increase
- **DE-STA-CO:** reduced omitted parts 800 to 10 ppm with a 15-30% productivity increase.

Source: Productivity Inc. and Shingo prize profiles

Mistake Proofing ROI

- **Dana** corporation has reported a \$500,000 savings resulting from a \$6 device.
- **Ortho-Clinical Diagnostics (Johnson & Johnson)** saved \$75000 annually by discovering a new use of Post-It® notes.
- **AT&T Power Systems** (Lucent Technologies) reported net saving of \$2545 per device (3300 devices).
- **Weber Aircraft** reports saving \$350,000 during their first year of implementation of approximately 300 devices.
- **GE Aircraft Engines** spends a minimum of \$500,000 on any in-flight shut-down (IFSD). Spending \$10,000 to stop one IFSD yields 50:1 benefit.

1-10-100 Rule

The 1-10-100 rule states that as a product or service moves through the production system, the cost of correcting an error multiplies by 10.

<u>Activity</u>	<u>Cost</u>
Order entered correctly	\$ 1
Error detected in billing	\$ 10
Error detected by customer	\$ 100

Dissatisfied customer shares the experience with others...

The difficulties with human error

Why existing tools are not enough

Motorola findings:

...it became evident early in the project that ... mistake-proofing the design would also be required ... Mistake-proofing the design is an essential factor in achieving the [total number of defects per unit] goal.

Smith, B. IEEE Spectrum 30(9) 43-47

Error proofing & SPC

- SPC is good at detecting shifts in the process mean or variance. Changes to the process must be ongoing to be readily detected.
- Human errors tend to be rare, intermittent events. They are not readily detected by control charts.
- Use error-proofing (not SPC) to reduce defects caused by human error

Motorola got an order of magnitude closer to their goal using a combination of SPC and error-proofing.

“Be more careful” not effective

- “The old way of dealing with human error was to scold people, retrain them, and tell them to be more careful ... My view is that you can’t do much to change human nature, and people are going to make mistakes. If you can’t tolerate them ... you should remove the opportunities for error.”
- “Training and motivation work best when the physical part of the system is well-designed. If you train people to use poorly designed systems, they’ll be OK for awhile. Eventually, they’ll go back to what they’re used to or what’s easy, instead of what’s safe.”
- “You’re not going to become world class through just training, you have to improve the system so that the easy way to do a job is also the safe, right way. The potential for human error can be dramatically reduced.”

Chappell, L. 1996. The Pokayoke Solution. *Automotive News Insights*, (August 5): 24i.

LaBar, G. 1996. Can Ergonomics Cure ‘Human Error’? *Occupational Hazards* 58(4): 48-51.

What Causes Defects?

1. Poor procedures or standards.
2. Machines.
3. Non-conforming material.
4. Worn tooling.
5. *Human Mistakes.*

Except for human mistakes these conditions can be predicted and corrective action can be implemented to eliminate the cause of defects

Inspection techniques

Inspection Techniques	Description
Judgment	Assesses quality of production outputs or sorts out defects from good product.
Informative	Assesses process by inspecting outputs and using information gained to control the process (a feedback loop).
Source	Assesses beforehand whether the conditions necessary for high quality production to exist.

Poka yoke

Mistake-proofing systems

Does not rely on operators catching mistakes

Inexpensive Point of Origin inspection

Quick feedback 100% of the time

Seven Guidelines to Poka Yoke Attainment

1. Quality Processes - Design "Robust" quality processes to achieve zero defects.
2. Utilize a Team Environment - leverage the teams knowledge,experience to enhance the improvement efforts.
3. Elimination of Errors - Utilize a robust problem solving methodology to drive defects towards zero.
4. Eliminate the "Root Cause" of The Errors-Use the 5 Why's and 2 H's approach.
5. Do It Right The First Time - Utilizing resources to perform functions correctly the "first" time.
6. Eliminate Non-Value Added Decisions - Don't make excuses - just do it !
7. Implement an Incremental Continual Improvement Approach - implement improvement actions immediately and focus on incremental improvements; efforts do not have to result in a 100% improvement immediately.

Poka Yoke Systems Govern the Process

Two Poka Yoke System approaches are utilized in manufacturing which lead to successful zero defect systems:

1. Control Approach

Shuts down the process when an error occurs.

Keeps the “suspect” part in place when an operation is incomplete.

2. Warning Approach

Signals the operator to stop the process and correct the problem.

Common Mistake proofing Devices

- Guide Pins
- Blinking lights and alarms
- Limit switches
- Proximity switches
- Counters
- Checklists

Methods for Using Poka yoke

Poka yoke systems consist of three primary methods:

1. Contact
2. Counting
3. Motion-Sequence

Each method can be used in a control system or a warning system.

Each method uses a different process prevention approach for dealing with irregularities.

Contact Methods

Do not have to be high tech!

Passive devices are sometimes the best method. These can be as simple as guide pins or blocks that do not allow parts to be seated in the wrong position prior to processing.

Take advantage of parts designed with an uneven shape!

A work piece with a hole a bump or an uneven end is a perfect candidate for a passive jig. This method signals to the operator right away that the part is not in proper position.

Counting Method

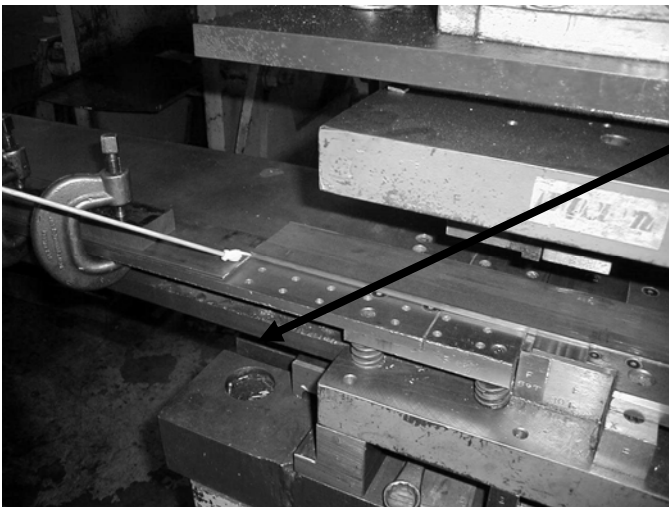
Used when a fixed number of operations are required within a process, or when a product has a fixed number of parts that are attached to it.

A sensor counts the number of times a part is used or a process is completed and releases the part only when the right count is reached.

Motion-Sequence Method

The third poka yoke method uses sensors to determine if a motion or a step in a process has occurred. If the step has not occurred or has occurred out of sequence, the the sensor signals a timer or other device to stop the machine and signal the operator.

This method uses sensors and photo-electric devices connected to a timer. If movement does not occur when required, the switch signals to stop the process or warn the operator.



Types of Sensing Devices

Sensing devices that are traditionally used in poka yoke systems can be divided into three categories:

1. Physical contact devices
2. Energy sensing devices
3. Warning Sensors

Each category of sensors includes a broad range of devices that can be used depending on the process.

3 Rules of POKA YOKE

- Don't wait for the perfect POKA YOKE. Do it now!
- If your POKA YOKE idea has better than 50% chance to succeed...Do it!
- Do it now....improve later!