Ten Types of Human Error

10. **Intentional errors**

Unfortunately, some people make mistakes deliberately, in an attempt to sabotage or commit a crime. These are least common, and should be dealt with as special cases.

Mistakes happen for many reasons, but almost all can be prevented if we take the time to identify when and why they happen and then take steps to prevent them by using Poka-Yoke methods and the safeguards listed above.

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**MANUFACTURING PROCESS**

Insert Components → Solder PWB → Assemble Faceplate
COST OF SOURCE INSPECTION

If we were to perform a complete visual inspection on each item after each operation, the cost would be prohibitive.

Therefore we perform these inspections using mechanisms and devices which offer the same feedback at no cost.


**Cause-Errors**

The Ten Most Common Errors  
*(Causes of Defects)*

1) Processing omissions  
2) Processing errors  
3) Error in setting up the workpiece  
4) Assembly omissions (missing parts)  
5) Inclusion of wrong part/item  
6) Wrong Workpiece  
7) Operations errors  
8) Adjustment, measurement, dimensional errors.  
9) Error in equipment maintenance.  
10) Error in preparation of blades, jigs, or tools.

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**Common Defect Categories**

1. Damaged parts/product  
2. Reversed parts/product  
3. Foreign matter present  
4. Mismatched parts  
5. Misaligned parts  
6. Wrong or inconsistent dimensionality  
7. Unable to be assembled  
8. Inconsistent test results/test failure  
9. Bad incoming material  
10. Wrong material or parts  
11. Other...
WHY WE MAKE ERRORS
(RED FLAGS)

- Adjustments
- Tooling change
- Too many parts, mixed parts
- Multiple steps
- Symmetry
- Rapid repetition
- High volume
- Environmental conditions
- Infrequent production
- Asymmetry

RED FLAG CONDITIONS
(Adjustments)

Definition
- Bring parts, toolings, fixtures into correct position

Redflag
- Making adjustment to what looks or feels right
- Rely on memory, own opinion or intuition
- Not enough time or skills
- Too many adjustments or micro-adjustments

Results
- Defects Occur
**REDFLAG**

*(Tooling/Tooling Change)*

**Definition**
- Tooling needs to be changed when we need to make a different unit or a tool is broken

**Redflag**
- It escapes our notice that tool is worn or broken
- Wrong tool is changed
- Tool is set incorrectly
- New tool requires adjustment

**Result**
- Defects Occur

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**REDFLAG**

*(Dimensions/Specifications/Critical Conditions)*

**Definition**
- Measurement for determining precise spatial position or location
- Specification/Critical Condition
  - temperature
  - pressure
  - volume

**Redflag**
- Variation in dimension/specification leads to error
- Operating conditions, skills, machine and material cause errors
**REDFLAG**

(Many Parts/Mixed Parts)

**Definition**
- Many operations requiring wide range of parts in varying quantities.
- Mixed parts, many parts in assembly and subassembly

**Redflag**
- Similar Parts
- Parts masked during assembly
- Too many parts

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**POKA-YOKE SYSTEM**

- Two Major Functions
  - Inspection 100%
  - Immediate Feedback and Action

- Regulatory Function
  - According to Purpose/Methods

- Setting Function
  - Techniques Used
REGULATORY FUNCTIONS

- Control Methods
  - When abnormalities occur
    - Shuts down machines or stops operations and prevent defects
  - Mechanisms detect trouble and humans take action (Pre-automation)
- Sometimes separate units by a mark and continue and then spot and fix
- Warning Methods
  - When abnormalities occur, a buzzer activities or light blinks
  - Lights and sound

- Control type methods more powerful than warning methods

SETTING FUNCTIONS

- Contact Methods
  - Detection of abnormalities through contact between products and devices
- Fixed Value Methods
  - Detection of abnormalities by checking number of motions where operations are repeated a number of times
- Motion Step Method
  - Detection of abnormalities through check of errors in standard motions where operations are done in predetermined motions.
DETECTION METHODS

- Limit switches, microswitches
  - Presence and position of objects
- Touch Switches
  - Light touch on antenna to detect presence and position of object
- Differential Transformers
- Proximity Switches
  - Changes in distance from objects and to changes in lines of magnetic force
- Photoelectric switch
  - Transmission type respond to interruption
  - Reflection type

DETECTION METHODS

- Electronic Beam Sensors (Transmission and reflection type)
- Fiber Sensors
- Area Sensors (use of light beams)
- Position Sensors
- Dimension Sensors
  - Whether dimensions are correct
- Color Marking Sensors
- Vibration Sensors
- Temperature Sensors
CHARACTERISTICS OF POKA-YOKE DEVICES

- Inexpensive
- Simple and easy to implement
- Specifically focused
- Developed by every employee
- Prevent errors
- Detect errors
- Detect defects

HOW IS IT DONE? (7 steps)

1. Describe the defect. Show the detect rate.
2. Identify the location where the defect was found and made.
3. Detail the current standard procedures where the defect was made.
4. Identify any errors or deviations from the standards.
5. Investigate and analyze the causes for each error. (Ask why the error happens until the root cause is identified.)
6. List alternative ways/ideas to eliminate or detect the error.
7. Create a Poka-Yoke device. Test for results.
**THE IMPROVEMENT CYCLE**

We start by adhering to the current procedures or the way we do things now

- **Adherence**

- **Standardization**
  We standardize the successful improvement and continue the cycle

- **Analysis**
  We analyze what we are doing and results we are

- **Improvement**
  Based upon our analysis, we take improvement action.

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**COMMON POKA-YOKE DEVICES**

- Guides/interference rods or pins
- Templates
- Counters
- Limit Switches
- Critical condition indicator

- Redesign for symmetry
- Redesign for asymmetry
- Sensors
- Odd part out method
- Sequence restriction
**Generation of Poka-Yoke Devices**

*Generated by: Production Associates, Supervisors, Engineers*

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**EXAMPLE: RIVETING OPERATIONS**

**Process:** Riveting coupling bars  
**Defect:** One bar joined upside down.

The bottom bar has a round hole on one end and an elliptical one on the other. It was possible to put the bar on the jig with the holes on the wrong sides to join them that way, resulting in defects.

**Operation Steps: Standard Procedure.**

1. Pick up part with elliptical hole.  
2. Place part onto machine bed.  
3. Pick up part with two round holes.  
4. Place second part over first part.  
5. Pick up rivet from parts box.  
6. Place rivet through both parts.  
7. Cycle machine to rivet parts together.  
8. Remove finished assembly from machine.
EXAMPLE (CONTINUED)

1. Describe the defect. Show the defect rate.

2. Location where defect was:
   Found -
   Made -

EXAMPLE (CONTINUED)

3. Detail current standard procedures where defect was made.

4. Identify any errors or deviations from the standard.
5. Investigate and analyze the causes for each error. (ask why the error happens until the root cause is identified)

6. List alternative ways/ideas to eliminate or detect the ERROR.
**EXAMPLE (CONTINUED)**

7. Create a Poka-Yoke Device. (Draw Device)

Cost to install: _____  Time to install: _____

Type I _____  Type II _____  Type III _____

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**POKA-YOKE PROBLEM #1**

**Process:** A shaft is joined to a chassis by staking.

**Defect:** Shaft is being inserted in reverse.

**Before Improvement:** One end of the shaft was grooved for an E-ring, while the other end had no groove. Aside from that difference that shaft was symmetrical and the operator could join the shaft to the chassis with either end.

This resulted in the E-ring not being able to be mounted during later assembly.
POKA-YOKE PROBLEM #2

Process: Washers are packed into delivery boxes by threading 25 at a time onto rods, then pack 4 rods into each box, resulting in 100 washers per box.

Defect: Wrong number of washers packed per box.

Before Improvement: Sometimes the rods had 24 or 26 washers threaded on, and the boxes ended up with the wrong number of washers. In addition, the rods were hard to handle when they were loaded with washers.

WORKSHEET FOR DEVELOPING POKA-YOKE

Step 1: Describe the defect.

Show the defect rate:

Step 2: Identify the location at which the defect is:

DISCOVERED: ________________________________
MADE: ________________________________

Step 3: Detail the current standard procedures of the operation where the defect is made.

______________________________
______________________________
Step 4: Identify any errors or deviations from the standards where the defect is made.

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Step 5: Analyze the causes for each error. (Ask why the error happens until root cause or source error is identified)

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WORKSHEET FOR DEVELOPING POKE-YOKE

Step 6: List alternative ways/ideas to eliminate or detect the error.

__________________________________________________________________________

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WORKSHEET FOR DEVELOPING POKE-YOKE

Step 7: Create Poka-Yoke device (draw device)

Cost to install: _____  Time to install: _____

Type I _____  Type II _____  Type III _____