

# A TUTORIAL ON POKA-YOKE

What will quality be like in the year 2000 and what will customers expect?

No matter what new technology is invented, what culture you operate in, or what the economics of the time dictate, one of the basic tenets of Total Quality Management (TQM), the customer defines "quality," will still be valid. A company which provides high quality products and services will still hold a competitive advantage over those who don't. However, with the world "shrinking" due to factors such as free trade and the explosion of electronic communication, the challenge will be to continually improve operations via solutions which are more cost competitive than your competitors. Companies must, therefore, rethink their operations and consider how to do things in such a way as to not just reduce but eliminate defects altogether. This is where the concept of Poka-Yoke, or mistake proofing of operations, comes in.

To understand the basic premise of Poka-Yoke, let's first think about what causes defects.

Defects can be caused by a variety of factors including:

- cultural factors such as awareness, attitudes, incentives, reward systems, and the level of commitment of the individuals and organizations involved,
- variance or the random and inherent differences between process outputs,
- complexity factors such as the number of separate parts, lack of commonality, etc. (a good definition of complexity for our purposes is the number of opportunities for defects to be caused), and
- mistakes or human errors which include incorrect intentions or executing correct intentions that result in unintended outcomes.

Thankfully, we have a large variety of tools and techniques to help us eliminate defects:

Cause of Defect	Applicable Tools
<b>Cultural factors</b>	<ul style="list-style-type: none"> <li>• Formation of teams</li> <li>• Management commitment</li> <li>• Driving out fear</li> </ul>
<b>Variance</b>	<ul style="list-style-type: none"> <li>• Statistical Process Control</li> <li>• Taguchi, Design of Experiments</li> </ul>
<b>Complexity</b>	<ul style="list-style-type: none"> <li>• Design for Manufacturability (DFX)</li> </ul>
<b>Mistakes</b>	<ul style="list-style-type: none"> <li>• Poka-Yoke</li> </ul>

Thus, Poka-Yoke devices are specifically designed to eliminate mistakes before they become a defect. Let's study the issue of mistakes a little further. When it comes to understanding mistakes and how they translate into defects, there are two basic rules we must remember:

**Rule #1: Errors Cause Defects** --- When a defect occurs on an assembly line, it is because an error occurred. The system may be designed in such a way that the occurrence happens as part of the common variation or it may be a special cause. Either way, the error is what caused the defect. An example of this is as follows: Placing an incorrect part on a circuit pack is a defect. The error which produces the defect may be that the operator picked up the wrong part or it may be that the "wrong" part was in the "right" bin, or it could be that the drawing/specification calls for the wrong part.

**Rule #2: To Err is Human** --- Have you ever driven to work and not remembered it? Forgotten a family member's birthday or your anniversary? Driven home from work intending to stop at the grocery store along the way but all of a sudden found yourself in your driveway with the realization that you had not stopped? This happens to workers too! Workers finish the shift and/or the build of a specific item and don't remember what they have done. Another example: After building green widgets all morning, the workers put green parts on the red widgets in the afternoon.

So, knowing these two rules, what can you do as a manager to eliminate mistakes?

You basically have two options:

- Demand vigilance by exhorting workers to be more careful. If you see the words “Instructed worker in the correct procedure and gave disciplinary warning” on a control chart, this is exactly what you are doing. An incentive system to encourage error-free performance is a positive feedback attempt to demand vigilance
- Mistake-proof the operation by changing the process to eliminate the chance of making the error in the first place.

The second option is what Poka-Yokes are all about. Basically, Poka-Yoke is a method of developing tools, techniques and processes which prevent or detect an error before it turns into a defect. Focus is on prevention/detection before the error proceeds downstream and turns into a defect. The first priority is to prevent errors. However, when this is not possible, you want to at least detect the error before it heads downstream and is seen as a defect to the end customer or next-in-line customer.

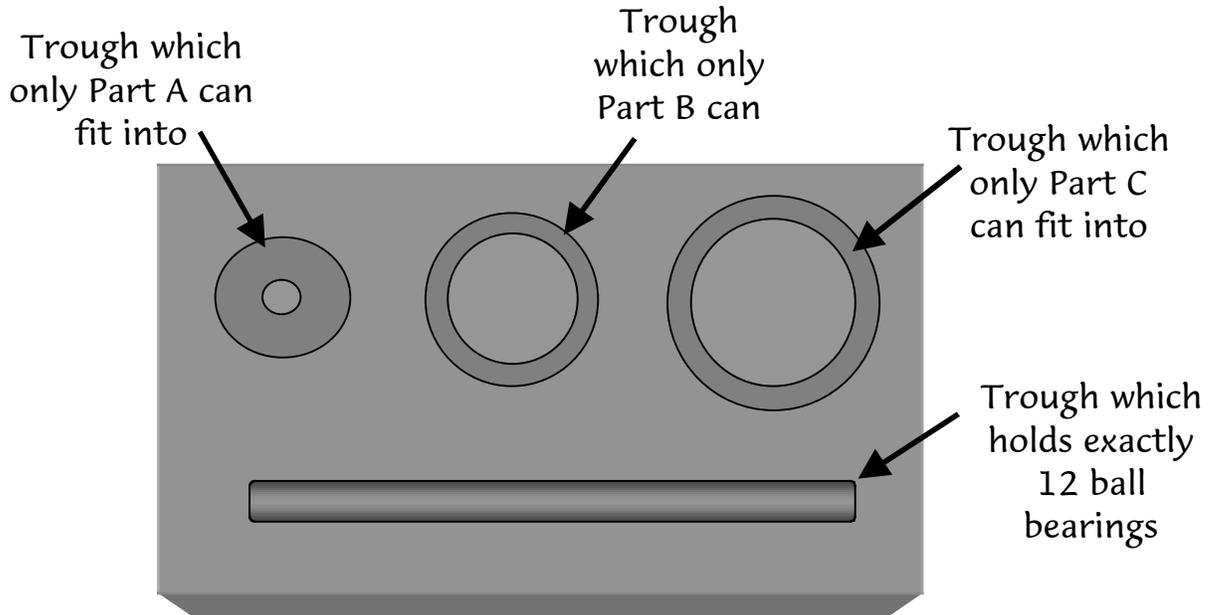
Let's take a look at an example:

A company manufactures drill bits with the operator counting ball bearings and small parts from a set of bulk bins as he/she removes the parts from the bins and loads them in the housing of the drill bit. Interruptions, daydreaming or loss of count can result in an insufficient number or wrong count of the individual parts being installed for the retention system of the drill bit. Once the housing is assembled, only destructive testing can reveal the quantity of ball bearings and small parts installed. Thus the defect, having the wrong number of ball bearings or a missing part of the assembly, will likely go undetected. In this case, the drill bit will operate under the vast majority of parameters with the defect inducing a failure only under very specific conditions (occurs while drilling a deep or high cost oil/gas well). By performing destructive testing on field returns, the company correlates failures with missing ball bearings.

So, what options do you have to try to solve this problem. You can . . .

1. call all your operators together and exhort them to pay attention when they are counting the number of ball bearings,
2. analyze the number of field returns to correlate defects to a specific operator and devise a demerit system which punishes workers who have too many defects and rewards those who are diligent,

3. change the design of the housing to enable an inspector to see whether the correct number of components is present, or
4. design a small fixture (see Figure 1) which the operator will load before he/she places the parts in the housing.



**Figure 1: Poka-Yoke Device for Correct Count of Parts in Drill Bit**

Of course the correct answer is #4. When the operator uses the Poka-Yoke device, he/she does not even need to try to count the number of ball bearings or keep track of whether the other parts have been installed or not. Instead the operator just grabs a hand full of ball bearings from the bulk bin and places them into the trough until it is full. Likewise, he/she will select the other parts from the bulk bins and load the parts into the appropriate cavities of the fixture. The operator does not begin loading the housing of the drill bit until the fixture is completely full. Thus, the operator does not need to worry about interruptions or of losing count during the assembly process. For these reasons, the operator can accomplish the job in less time than it actually took under the old method. This is often the case with Poka-Yokes – not only do they eliminate or detect the error but they often speed up the operation in question and reduce the cost.

**Why are Poka-Yokes so effective and why should you be interested in them?**

Using Poka-Yokes to eliminate defects is effective because they attack defects at their source by focusing on prevention and detection of errors. Don't make the mistake of thinking that the concept can only be applied to manufacturing – it applies to all functions and processes in a business: sales, marketing, distribution, R & D, manufacturing, warehousing, billing, and customer service.

The technique of mistake-proofing is a very powerful tool because...

1. it is so very easy to understand (the best creators of Poka-Yoke devices are usually the operators themselves),
2. it is grounded in common sense (unfortunately it seems there is not much of this around at times),
3. the devices are very inexpensive (massive undertakings of major machinery and computer systems are not required), and
4. by challenging the imagination of the workers, Poka-Yoke encourages innovation.

There are opportunities for Poka-Yoke devices everywhere – turn your workforce loose and challenge them to find places to eliminate defects, safety problems, design problems, confusion, etc.

Pepsan & Associates, Inc. are proven experts at implementing Poka-Yokes in many environments. A good starting point is our one day training and problem-solving package where workers are trained in the basic concepts (1/2 day) and then the technique is applied to actual problems being experienced by the client (1/2 day). If you are interested in knowing more about how you might make Poka-Yoke work for your business, please contact us at [info@pepsan.com](mailto:info@pepsan.com).