

**POKA-YOKE MISTAKE PROOFING**

NARRATOR:

MANUFACTURING INSIGHTS... MANUFACTURING ENGINEERING MAGAZINE'S VIDEO SERIES FOR INDUSTRIAL MANAGEMENT.

NARRATOR:

THIS PROGRAM LOOKS AT MISTAKE PROOFING...OR POKA-YOKE... AND SHOWS HOW COMPANIES ARE USING IT TO ELIMINATE ERRORS AND DEFECTS THROUGHOUT THEIR OPERATIONS.

SCENE 7

WE'LL SEE HOW UNITED ELECTRIC CONTROLS COMPANY BUILDS ITS OWN POKA-YOKE DEVICES BASED ON WORKERS' SUGGESTIONS...

SCENE 8

...WHY TRW'S AUTOMOTIVE AIR BAG MANUFACTURING OPERATION USES POKA-YOKE DEVICES ON VIRTUALLY EVERY PIECE OF EQUIPMENT IN THE PLANT...

SCENE 9

...AND HOW, AT FORD'S ENGINE PLANT NUMBER TWO NEAR CLEVELAND, THE USE OF POKA-YOKE HAS REDUCED MANUFACTURING DEFECTS TO NEARLY ZERO.

SCENE 10

POKA-YOKE IS THE JAPANESE TERM FOR MISTAKE PROOFING, A METHODOLOGY PERFECTED BY DR. SHIGEO SHINGO, JAPANESE MANUFACTURING EXPERT. ITS USED IN TWO BASIC WAYS:

SCENE 11

NARRATOR VO:

(GRAPHIC) FIRST, TO PREVENT ERRORS FROM ERROR PREVENTION OCCURRING IN THE FIRST PLACE... ERROR DETECTION AND CAUSE IDENTIFICATION AND SECOND, IF AN ERROR DOES OCCUR, TO ENSURE THAT IT IS DETECTED AND ITS CAUSE QUICKLY IDENTIFIED.

POKA-YOKE REQUIRES AN ABRUPT CHANGE IN TRADITIONAL THINKING...FROM THE CONVENTIONAL CONCEPT THAT PEOPLE ARE FALLIBLE AND THUS WILL ALWAYS MAKE MISTAKES...TO YES, PEOPLE ARE INDEED FALLIBLE BUT THERE ARE A MYRIAD OF WAYS TO KEEP THEM FROM MAKING MISTAKES. POKA-YOKE ALSO RECOGNIZES THE FACT THAT PEOPLE DON'T WANT TO MAKE MISTAKES, AND WHEN DO, THEY ARE OFTEN RELUCTANT TO REPORT THEM. COMPANIES THAT USE POKA-YOKE SUCCESSFULLY, THEREFORE OPERATE UNDER A POLICY OF "NO BLAME". IN FACT, THEY ENCOURAGE THEIR WORKERS TO REPORT

MISTAKES AS THEY OCCUR. THIS IS THE FIRST STEP IN THE POKA-YOKE PROCESS, WHICH SEEKS THE ANSWERS TO THREE QUESTIONS:

SCENE 12

NARRATOR VO:

(GRAPHIC) . HAS AN ERROR OCCURRED? IF SO, WHY DID IT OCCUR? WHAT IS THE BEST WAY TO PREVENT IT FROM OCCURRING AGAIN? ALTHOUGH SOME POKA-YOKE DEVICES EMPLOY SOPHISTICATED TECHNOLOGY, MANY ARE SURPRISINGLY SIMPLE AND INEXPENSIVE. THE FIVE MOST COMMON ARE:

SCENE 13

NARRATOR VO:

1. GUIDE PINS, RAILS AND SIMILAR DEVICES TO ENSURE THAT THE WORK OR GUIDE PINS OF A TOOL ARE PROPERLY ALIGNED.
2. ERROR DETECTION ALARM.
3. LIMIT SWITCHES TO ENSURE THE CORRECT PLACEMENT OF A TOOL OR PART.
4. COUNTERS TO GUARANTEE THAT THE CORRECT NUMBER OF EVENTS HAVE OCCURRED IN A GIVEN PROCESS.
5. AND SIMPLEST OF ALL, A PRINTED CHECKLIST DISPLAYED AT A WORK STATION TO ENSURE THAT ALL NECESSARY STEPS IN A PROCESS HAVE BEEN COMPLETED.

SCENE 14

AS WE WILL SEE IN THIS PROGRAM, AS MANUFACTURING PROCESSES BECOME MORE AUTOMATED AND COMPLEX, SO DO THE POKA-YOKE DEVICES USED TO CONTROL THEM. BUT WHATEVER FORM THEY TAKE, ALL SHARE A COMMON GOAL: TO REDUCE MISTAKES IMMEDIATELY AND, EVENTUALLY, TO ELIMINATE THEM ENTIRELY.

SCENE 15

CG: ROSS ROBSON, Ph.D.  
EXECUTIVE DIRECTOR  
SHINGO PRIZE FOR EXCELLENCE IN MANUFACTURING  
ROBSON ON-CAM (03:14:30 - 03:15:10)

Poka-yoke is one of a number of very, very important disciplines, manufacturing systems, that every company, every organization, every service organization should incorporate into their value system, their processes, in everything they do, and it's simply an attempt to mistake-proof what it is you do, whether it's a service, whether it's research and development, product development, or whether it's actual manufacturing.

SCENE 16

ROBSON ON-CAM (03:19:24 - 03:19:44)

There are multiple types of poka-yoke applications. One is you can't put the part into a machine incorrectly. Another is that you would have a sensor to detect whether the part is in fact in place.

SCENE 17

ROBSON ON-CAM (03:20:00 - 03:20:31)

The genius of poka-yoke is that you train your people, the people who are actually doing the job, around the methodology, the thought processes of poka-yoke, whereby they then devise the mistake-proofing apparatuses-- templates, systems for their own work center.

SCENE 18

ROBSON ON-CAM (03:20:42 - 03:21:03)

They ought not to be expensive applications. No doubt there are some out there that are relatively expensive, but the notion is simple, easy. After training, any production person could develop a poka-yoke application.

SCENE 19

NARRATOR:

POKA-YOKE HAS MULTIPLE GOALS, THE ULTIMATE BEING THAT OF ZERO DEFECTS.

SCENE 20

ROBSON ON-CAM (03:18:00 - 03:18:31)

It's economic, it's quality, it's customer service, it's customer satisfaction. It has as a discipline an attempt to perfect everything we do. Some people are in fact using perfection as the goal, as the target. Other people talk about six sigma. Six sigma is simply 3.4 mistakes per million opportunities. I see that as being right at zero defects.

SCENE 21

MANY OF THE RECIPIENTS OF THE BALDRIGE AWARD AND THE SHINGO PRIZE HAVE BUILT THEIR OPERATIONS AROUND THE CONCEPT OF POKA-YOKE.

SCENE 22

ROBSON ON-CAM (03:24:00 - 03:24:20)

Two of the case studies in this video are Shingo recipients-- United Electric Controls in 1989 and Ford Engine Plant No. 2 in 1996. Both in their individual rights have outstanding examples of poka-yoke applications.

SCENE 23

ROBSON ON-CAM (03:28:39 - 03:28:59)

There is no more powerful methodology or discipline, in my estimation, in the marketplace today, to utilize or to incorporate, to achieve zero defects through the process of mistake-proofing upstream than poka-yoke.

SCENE 24

ROBSON ON-CAM (03:29:15 - 03:29:49)

I am familiar with TRW's processes for poka-yoke and intimately familiar the Ford Engine Plant No. 2 and United Electric Controls. All three are outstanding examples of the utilization and incorporation in their manufacturing and business processes to mistake-proof, to insure that no machine or human-made error ever gets in the hands of the customers.

-FTB-

SCENE 25

NARRATOR:

UNITED ELECTRIC CONTROLS COMPANY MANUFACTURES TEMPERATURE, PRESSURE AND VACUUM CONTROLS FOR A WIDE VARIETY OF CUSTOMERS. MANY OF THE FIFTEEN HUNDRED FIXTURES USED ON ITS MACHINES ARE EQUIPPED WITH POKA-YOKE DEVICES SUGGESTED BY SHOP FLOOR WORKERS.

SCENE 26

CG: PAUL PLANT

MANAGER OF PROCESS IMPROVEMENT

PLANT ON-CAM (02:XX:XX PAGE 2, PARAG 2)

We ask people that are using the fixtures, if they make a defect that they write it up using our suggestion system.

SCENE 27

PLANT ON-CAM (02:XX:XX PAGE 2, PARAG 2)

We don't ask them to have a solution. All they need to do is write it up to get it corrected. This allows those of us in the Tool and Fixture area to go out and look at the fixture with the person who wrote the suggestion, and come up with a poka-yoke device to go into place to eliminate whatever that problem is.

SCENE 28

NARRATOR:

THE COMPANY USES WHAT IT CALLS "ACTION CENTERS" TO START THE POKA-YOKE PROCESS.

SCENE 29

PLANT ON-CAM (02:XX:XX PAGE 2, PARAG 3)

An action center at United Electric is a group of people that get together to solve a specific problem. Anyone in the company can start an action center. They can also ask anyone in the company to be a part of an action center. Basically what you do is sit around the table, discuss the problem. and try to come up with solutions.

SCENE 30

NARRATOR:

ONE POKA-YOKE DEVICE INVOLVES MAKING SURE THAT THE AMOUNT OF AIR PRESSURE IN AN AIR-OVER-OIL PRESS IS ALWAYS SET CORRECTLY.

SCENE 31

PLANT VO (02:XX:XX PAGE 1, PARAG 6)

We use various fixtures on that piece of equipment, and in the past the operator would have to remember to set the air pressure at a certain setting to get the right pressure for the job they're trying to do on that press.

SCENE 32

NARRATOR VO:

PINS WERE ADDED TO THE BOTTOM OF THE PRESS WHICH WHEN DEPRESSED, ACTUATE A PNEUMATIC SWITCH, WHICH IN TURN ROUTES THE AIR PRESSURE THROUGH THE REGULATOR TO PRODUCE THE PROPER PRESSURE.

SCENE 33

PLANT VO (02:XX:XX PAGE 1, PARAG 6)

The bottoms of the fixtures now have holes in them, so when you put the fixture on the press, it would depress the proper pin to get the proper air pressure for that particular fixture. So the operator no longer has to remember to set the air pressure for that press. It does it automatically for you. It takes the judgment out of the fixture.

SCENE 34 NARRATOR:

ANOTHER EXAMPLE OF A POKA-YOKE DEVICE INVOLVES A TERMINAL BLOCK ASSEMBLY WHOSE INSULATOR CAN BE INCORRECTLY INSTALLED. THE CORRECT ASSEMBLY SEQUENCE IS TERMINAL BLOCK, INSULATOR, AND METAL PLATE ON THE BOTTOM. HOWEVER, IT IS EASY TO ACCIDENTALLY PLACE THE METAL PLATE BETWEEN THE BLOCK AND THE INSULATOR. THE PROBLEM WAS SOLVED BY MAKING THE METAL PLATE, WHEN PROPERLY POSITIONED, PART OF AN ELECTRIC CIRCUIT THAT ALLOWS THE MACHINE TO OPERATE.

SCENE 35

PLANT VO (01:17:27 - 01:17:44)

Inside the fixture we have a normally closed solenoid valve and we added these two little contacts. These two contacts, when you put the metal plate on, it picks up the two contacts and opens the solenoid valve.

SCENE 36

PLANT VO (01:18:00 - 01:18:13)

If you put the insulator on first and then the metal plate, the fixture won't operate because there's no way the metal plate can pick up the contacts through the insulator.

SCENE 37

PLANT ON-CAM (02:10:42 - 02:10:50)

These devices will eliminate a problem completely. If you do it correctly, you'll never have to deal with that problem again.

-FTB-

SCENE 38

NARRATOR:

THE KEY TO A SUCCESSFUL POKA-YOKE PROGRAM IS THE TOTAL INVOLVEMENT OF THE WORKFORCE AND ELIMINATING THE CONCEPT OF BLAME FOR ERRORS.

SCENE 39

CG: BRUCE HAMILTON

VICE PRESIDENT OF OPERATIONS

HAMILTON ON-CAM (03:01:58 - 03:02:14)

The workforce has led the way. However, the most difficult thing, I think, in terms of gaining insight, is changing the mind set that if you report a problem, they may shoot the messenger.

SCENE 40

HAMILTON ON-CAM (03:02:42 - 03:03:03)

So the key is creating an environment in which employees will be rewarded for reporting problems. Management has to change its point of view and say, thank you very much. If an employee as experienced as you could have created this defect, then who knows what could happen in your absence, and we're going to take a look at this and fix it.

SCENE 41

NARRATOR:

IN ADDITION TO SUBSTANTIALLY IMPROVING PRODUCT QUALITY, POKA-YOKE CAN ALSO GREATLY IMPROVE THE OVERALL PRODUCTION PROCESS.

SCENE 42

HAMILTON ON-CAM (02:27:48 - 02:28:10)

Poka-yoke is really part of eliminating overproduction, because if you need to produce only what the customer needs, then you need to be sure that you're not producing a defect. If you're producing a defect, and you know that defects are being produced, you'll always produce extra to accommodate for that defect.

SCENE 43

NARRATOR:

SINCE PART REDUNDANCY IS NOT REQUIRED TO REPLACE DEFECTIVE COMPONENTS, UNITED ELECTRIC CAN EMPLOY ONE-PIECE FLOW MANUFACTURING, WITH ALL PRODUCTS PRODUCED COMPLETE, ONE BY ONE.

SCENE 44

HAMILTON ON-CAM (03:00:50 - 03:01:15)

Poka-yoke give you an opportunity at any point in the process where you know you're producing defects, to reduce that error to zero without any risk to the production process. It doesn't require that you reduce your batch. It doesn't require that you rearrange the factory. It doesn't require that you retrain your employees. It doesn't cost very much, and it always produces zero defects.

SCENE 45

HAMILTON ON-CAM (03:07:34 - 03:07:43)

It's really designed to produce zero defects so you can have one-piece flow. It's there for that reason. It's not there to enable you to sort out scrap.

SCENE 46 NARRATOR:

EXPLAINING TO THE WORKFORCE WHAT POKA-YOKE IS ALL ABOUT IS ESSENTIAL FOR SUCCESS.

SCENE 47

HAMILTON ON-CAM (03:07:49 - 03:08:07)

They need to know why you would be doing this. It enables them to identify the problem. Shingo correctly pointed out that eliminating waste is not the problem. It's being able to identify the problem. That's problem No. 1, trying to figure out what the problem is.

SCENE 48  
NARRATOR:

THE SIMPLEST SOLUTION TO SOLVING THE PROBLEM IS OFTEN THE BEST SOLUTION.

SCENE 49  
HAMILTON ON-CAM (03:08:22 - 03:08:35)

The next thing is, there is a method to not just identifying an opportunity for poka-yoke, but a method for approaching solutions and trying to figure out which type of device you can use.

SCENE 50  
HAMILTON ON-CAM (03:08:47 - 03:08:56)

We have some of our most creative poka-yoke done with cardboard and scotch tape, and they were done in 10 minutes and cost less than two dollars.

-FTB-

SCENE 51  
NARRATOR:

TRW'S PLANT IN COOKEVILLE,  
(TRW B: 02:16:08 +)  
TENNESSEE, PRODUCES PASSENGER SIDE AIR BAGS. SINCE IT IS ESSENTIAL THAT THESE DEVICES WORK FLAWLESSLY WHENEVER NEEDED, THE COMPANY USES POKA-YOKE TO ENSURE TOTAL PRODUCT RELIABILITY.

SCENE 52  
CG: MARK HORTON  
MANAGER OF PRODUCT & PROCESS IMPROVEMENT  
TRW  
HORTON ON-CAM (01:12:57 - 01:13:20)

A defects normally exists two states. It's either about to occur or it has occurred. The function of a poka-yoke device is to control the process by either shutting down an operation when a defect occurs or by giving a warning to the operator that a defect has occurred, so they know to look in the process, to correct the problem.

SCENE 53  
HORTON ON-CAM (01:15:53 - 01:16:16)

We use mistake-proofing in virtually every piece of equipment in our facility. Some typical examples, and you would find that throughout assembly operations no matter what plant you might go in, sensing for part presence and part orientation. We normally would do this using a photoelectric or proximity sensor.



SCENE 54

HORTON ON-CAM (01:19:40 - 01:19:47)

Photoelectric sensors and proximity switches are basically switches. They are tied to a programmable logic controller.

SCENE 55

HORTON ON-CAM (01:20:06 - 01:20:24)

The fixture would have a proximity sensor in place to verify that the part had been put in the proper position. When that sensor is made, it sends a signal to the programmable logic controller, which tells the operator to then take the next step in the process.

SCENE 56

NARRATOR:

IN ADDITION TO PROXIMITY SENSORS, THE COMPANY MAKES EXTENSIVE USE OF VISION SYSTEMS.

SCENE 57

HORTON ON-CAM (01:20:40 - 01:21:06)

Vision systems are a great tool. They are very flexible. That's probably the main benefit of a vision system. We use them at TRW on our production lines, mainly for sensing part presence, part orientation. A typical example would be a label, making sure we have the right label and the label was in the right location.

SCENE 58

NARRATOR:

TRW ALSO USES A WIDE VARIETY OF OTHER POKA-YOKE DEVICES IN ITS DRIVE TO TOTALLY ELIMINATE ERRORS.

SCENE 59

CG: BOB BOWEN

PRODUCT IMPROVEMENT FACILITATOR

BOWEN ON-CAM (01:01:42 - 01:02:13)

We have more than 250 devices for each line. This averages out to 25 to 30 mistake-proofing devices per station. Most of our devices, probably 50 percent or better, are electrical devices such as proximity switches and fiber optics. We use mechanical devices such as pins, slides, and positive locating features. We also use electromechanical devices such as feeder bowls to prevent contamination.

SCENE 60

BOWEN ON-CAM (01:04:59 - 01:05:32)

In our processing, a defect, when it occurs, can be handled in two different ways. On the automated assembly lines, a defect is labeled by a pallet. The reject continues through the process and is removed at a rework or re-loop operation. During our manual lines, a rework is bar coded in as a reject, and will be removed at that station. The bar code prevents the continued operation or continued processing of that part through the rest of the line.

SCENE 61  
NARRATOR:

BAR CODES ARE USED IN OTHER WAYS IN TRW'S POKA-YOKE PROGRAM.

SCENE 62  
BOWEN ON-CAM (01:08:21 - 01:08:37)

As part of our mistake-proofing program at Cookeville, operators have bar coded badges that they scan in at each station to say that the person has been certified to run that operation. The machine will not start up and run without that certification.

SCENE 63  
BOWEN ON-CAM (01:08:45 - 01:09:00)

The second part of that, the bar coded badges are used, if a rework or a reject does occur, it takes two qualified operators to verify that the rework has been performed correctly for the part to continue through the process.

SCENE 64  
NARRATOR:

INPUT ON WAYS TO PERFECT THE POKA-YOKE SYSTEM COMES FROM MANY SOURCES.

SCENE 65  
BOWEN ON-CAM (01:09:14 - 01:09:45)

Our mistake-proofing program is continuously improving. There are several areas we use to gain new ideas for mistake-proofing devices. We look at design changes. We look at customer concerns, customer requests, operator ideas. Our concern analysis report or problem solving, scrap and rework, and any kind of contamination or safety issues all bring up new ideas for implementation of mistake-proofing devices on our lines.

SCENE 66  
NARRATOR:

TRW ALSO USES THE PRINCIPLES OF POKA-YOKE IN DESIGN ENGINEERING. THE ULTIMATE GOAL IS TO DESIGN PRODUCTS IN SUCH A WAY THAT POKA-YOKE DEVICES WILL NO LONGER BE NEEDED IN THE PRODUCTION

PROCESS.

SCENE 67

HORTON ON-CAM (01:26:46 - 01:27:08)

We actually have a checklist we go through to evaluate features of the product that would potentially cause mistakes or cause us to have to add sensors or devices on our manufacturing lines. What we hope to do is make the product mistake-proof so we don't have to add the devices to our lines.

SCENE 68

HORTON ON-CAM (01:27:17 - 01:27:30)

So the ideal thing is not to have to have any devices, but to have the product go together one way, have a minimum number of parts, typical design for assembly-type things that you would look at.

SCENE 69

NARRATOR:

HOW EFFECTIVE HAS POKA-YOKE BEEN FOR TRW? AS IN MOST COMPANIES, IT IS JUST ONE OF MANY QUALITY IMPROVEMENT PROGRAMS WORKING IN PARALLEL, SO PRECISE FIGURES ARE HARD TO COME BY. BOB BOWEN COMES AS CLOSE AS HE CAN.

SCENE 70

BOWEN ON-CAM (01:10:15 - 01:10:43)

We use the parts-per-million returns. For 1995 TRW Cookeville had for mistake-proof processes a parts-per-million of less than 10. Our scrap and rework as a percent of standard cost of production was less the .6 percent. And also an airbag first pass yield of 99.5 percent. Those are some of the numbers that we feel our mistake-proofing program has contributed to.

-FTB-

SCENE 71

NARRATOR:

FORD MOTOR COMPANY'S ENGINE PLANT NUMBER TWO OPERATES BOTH A PARTS MACHINING LINE AND AN ENGINE ASSEMBLY LINE. THE USE OF POKA-YOKE IS CLOSE TO ELIMINATING ERRORS AND DEFECTS IN BOTH AREAS.

SCENE 72

CG: TIM PETTRY

PRODUCTION SYSTEM COORDINATOR

CLEVELAND ENGINE PLANT II

PETTRY ON-CAM (07:18:30 - 07:18:54)

We use mistake-proofing in both our engine assembly line as well as our machining lines. We machine the what we call, refer to as the five C's of an engine--the cylinder block, the cylinder head, the cam shaft, the crankshaft and the connecting rod. We use mistake-proofing throughout all operations in the plant.

SCENE 73

PETTRY ON-CAM (07:19:25 - 07:19:52)

In the machining lines we are focusing more on machine tooling, tool change-overs, and how we can keep, make sure that the proper tools are in the right holder, are in the right spindles, and then detect when we have a missing tool or the wrong tool. On the assembly line we are looking at the process more and is the process working right.

SCENE 74

PETTRY ON-CAM (08:03:04 - 08:03:20)

If somebody recognizes that there is an error or a problem has occurred, through team meetings, through working with the engineers, through working with all the people in the department, as well as vendors, we try to com up with solutions to the problem.

SCENE 75

PETTRY ON-CAM (08:05:04 - 08:05:20)

When we measure errors per thousand, in December of 1995 our 3 liter engine achieved zero errors per thousand after one month in service. It is a very good indicator that the things we are doing here are achieving the goals of being best in class, cost and quality.

SCENE 76

CG: SKIP PROKOP

U. A. W. TRAINEE FACILITATOR

PROKOP ON-CAM (07:07:30 - 07:07:59)

(GRAPHIC AND VO)

We have basically three levels of mistake-proofing that we use. We want our corrective actions for our problems to either correct the error or if that isn't possible, we want at least to identify the error, give feed-back to the operator so correction can be made to the error to prevent the defect, and if that is not possible, and there are a lot of time that it is not, we put in devices that at least detect the defect and keep it from moving on to the next station.

SCENE 77

PROKOP ON-CAM (07:10:15 - 07:10:43)

To control tool change over in the machining areas, we use various levels of mistake-proofing, anywhere from low level visual controls--we have some color coded holders that correspond with color coded drills. We have in our spindles that can hold the same size tool, but different tools. We use dowel pins and the tool holders are aligned with holes in the spindles so that they only fit in one area.

SCENE 78  
NARRATOR:

MANY TOOL HOLDERS ARE CODED SO THEY CAN BE USED ONLY IN CERTAIN SPINDLES.

SCENE 79  
PROKOP ON-CAM (07:10:44 - 07:10:59)

We also use spindle specific tool holders when they are delivered to the line, so that we ensure that we are getting the right tools to the right stations, that the holders are designed to correspond with the dowels and the holes in the tool holders.

SCENE 80  
NARRATOR:

AS THE WORKERS BECOME MORE FAMILIAR WITH POKA-YOKE, THEY ARE OFTEN ABLE TO MAKE SUGGESTIONS TO IMPROVE THE PROCESS.

SCENE 81  
PROKOP ON-CAM (07:14:18 - 07:14:41)

An example of that was our crank sprocket early on in the program. On the crank sprocket we had a thin wall and a thick wall. Well, the operator had to look for the thick wall or thin wall in order to put that on right. What we asked product to do was design it so that it was the same on both sides and that we could put it on without having to look. Of course, that took a change in our crankshaft to be able to do that.

SCENE 82  
NARRATOR:

AS AN AID IN MISTAKE-PROOFING, THE COMPANY USES WHAT IT CALLS A PROFILE GATE.

SCENE 83  
CG: CINDY ELLIS  
TEST ENGINEER  
ELLIS ON-CAM (07:02:36 - 07:02:52)

The profile gate basically monitors the engine as it travels down the line to make sure that is traveling in the correct orientation. So if it is off-

location, the profile gate will be activated by a switch and then the operator can go over and reposition the engine.

SCENE 84  
NARRATOR:

VISION SYSTEMS ARE USED TO ENSURE THAT ALL PARTS ARE PROPERLY INSTALLED ON THE ENGINE.

SCENE 85  
ELLIS ON-CAM (07:03:00 - 07:03:21)

One type is for the main bearings. It makes sure that the bearing is there, as well as in the correct orientation. Another system we have for vision is a timing station. Once the timing chains are put on, there are seven cameras that come in and take a quick snap-shot of the timing of the engine and make sure that it is properly timed.

SCENE 86  
NARRATOR:

FORD ALSO USES RADIO FREQUENCY..RF...TAGS TO DISTINGUISH BETWEEN ENGINES BOUND FOR THE NORTH AMERICAN MARKET AND THOSE HEADED FOR EUROPE.

SCENE 87  
ELLIS VO (07:05:15 - 07:05:43)

The RF strategy, basically that tag travels with that engine through the entire process so that when they go to put a part on, especially if it is a North American versus a European, a station where a manual job is done there is a marquee that displays whether it's an NAO or European by reading that particular RF tag for that engine. We use that through a lot of our manual operations throughout the entire assembly process.

SCENE 88  
NARRATOR:

FORD'S USE OF POKA-YOKE EXTENDS EVEN INTO THE AREA OF SHIPPING AND HANDLING.

SCENE 89  
PETTRY ON-CAM (07:21:50 - 07:22:01)

When we use mistake-proofing we have worked with our dunnage to design our dunnage that we use in shipping our products so that the dunnage fits together in a certain way.

SCENE 90  
PETTRY ON-CAM (07:22:07 - 07:22:37)

Particularly in our camshaft area, we have painted strips on the side of the dunnage that allows our hi-lo drivers when they are delivering parts to know that those stacks of dunnage are properly aligned if there is a straight line on that dunnage. If there is a broken line, then that hi-lo driver can recognize at a glance that one of the dunnage trays is misaligned.

SCENE 91  
NARRATOR:

NO POKA-YOKE PROGRAM, REGARDLESS HOW SOPHISTICATED, CAN HOPE TO SUCCEED UNLESS THE WORKFORCE IS TOTALLY INVOLVED AT THE OFFSET.

SCENE 92  
PETTRY ON-CAM (08:06:11 - 08:06:23)

In starting our mistake-proofing process, it was key for us to get that early involvement of the hourly people, the operators as well as the skilled tradesmen in the design of the equipment.

SCENE 93  
PETTRY ON-CAM (08:06:52 - 08:07:15)

That was key to our success and probably there can never be enough of that type of involvement. That would be the key to anybody's success in doing that--tap into the workforce. They are the ones who have lived the process, they have lived with the mistakes, they know how to make improvements. Just ask them and they will help you.

-FTB-

SCENE 94  
NARRATOR:

AS AMERICAN MANUFACTURING CONTINUES TO REINVENT ITSELF, THE QUESTION ARISES: WHAT FORM WILL IT TAKE FIVE OR TEN YEARS FROM NOW...AND WHAT ROLE WILL POKA-YOKE PLAY? TWO PROFESSORS FROM WAYNE STATE UNIVERSITY TAKE A LOOK AT THE FUTURE.

SCENE 95  
FRANK PLONKA, Ph.D  
PROFESSOR  
INDUSTRIAL & MANUFACTURING ENGINEERING  
WAYNE STATE UNIVERSITY  
PLONKA ON-CAM (04:05:43 - 04:06:11)

As we increase the complexity of products, we are starting to address agile manufacturing. The whole concept of agile manufacturing is to be able to hit windows of opportunity with product. I think in agile manufacturing, in areas

where you see more and more products being developed, products having a shorter life cycle, and processes having to be configured to build those products, I think the need for poka-yoke is going to increase.

SCENE 96

PLONKA ON-CAM (04:06:32 - 04:06:44)

So I think agile manufacturing is going to put more demand on zero quality or zero defects, and I think poka-yoke has to be implemented much faster and in a much more adaptable fashion.

SCENE 97

NARRATOR:

AS TODAY'S WORKFORCE AGES AND IS REPLACED BY YOUNGER, LESS EXPERIENCED WORKERS, POKA-YOKE SHOULD PROVE OF BENEFIT TO BOTH GROUPS.

SCENE 98

PLONKA ON-CAM (04:07:47 - 04:08:01)

If you look at the current workforce, which is starting to age, from studies on aging and industrial engineering that have been conducted, that as people become older their cognitive and decision-making time slows down.

SCENE 99

PLONKA ON-CAM (04:08:20 - 04:08:44)

So I see a real need for poka-yoke to make a contribution with the older workforce. On the other hand, if you look at the workforce that is entering factories today, they are much younger. They're quicker, they make decisions faster. They are also prone to make errors faster. So again I see that it's a win-win situation with poka-yoke, with both elements of the workforce.

SCENE 100

PLONKA ON-CAM (04:10:32 - 04:10:49)

I see the workforce themselves being a part of the design of poka-yoke devices, being part of the design of the workplace itself, and to brainstorm and work with process people and with suppliers, so that those processes are extremely capable.

SCENE 101

NARRATOR:

A NEW SCIENCE OF MANUFACTURING MAY WELL EMERGE, IN WHICH THE PRINCIPLES OF POKA-YOKE WILL PLAY AN IMPORTANT ROLE.



SCENE 102

PLONKA ON-CAM (04:16:48 - 04:16:58)

I think that if this country is going to really make real progress and real headway in terms of world-class manufacturing, then we're going to need a new science, a new way of designing processes.

SCENE 103

PLONKA ON-CAM (04:17:26 - 04:17:48)

I think the elements of that science are number one, mechatronics--how do you interface electronics with mechanical device. I think industrial engineering, human factors and ergonomics will be another principal part of this science. Psychology, understanding how people process information, is going to be another contributor to it. Computer science I think will play a major role.

SCENE 104

NARRATOR:

THE NEW MANUFACTURING SCIENCE SEEMS DESTINED TO BRING TOGETHER OTHER SCIENCES THAT TODAY OPERATE INDEPENDENTLY OF EACH OTHER.

SCENE 105

PLONKA ON-CAM (04:17:50 - 04:18:16)

When you look at the artificial intelligence, the neural networks, the computer science, to bring all that together, and to focus it on the workplace itself, and what it is going to take for people to become successful, I think will put us in a position to really make a contribution and to be very successful. The thing that I really get excited about is the fact that in doing so, we will allow people to be able to produce things at world-class prices and quality.

SCENE 106

NARRATOR:

AS THE VARIOUS ADVANCED TECHNOLOGIES MOVE INTO THE AREA OF POKA-YOKE, WE CAN EXPECT AN UNPRECEDENTED DISTRIBUTION OF LABOR BETWEEN MECHANICAL AND HUMAN RESOURCES.

SCENE 107

PLONKA ON-CAM (04:19:19 - 04:19:56)

I think that if we do an excellent job here of simplifying the work, then I think what we can do is offload that work to devices that have got primitive thinking and reasoning abilities. I see a new science here that will make people successful, and on the other hand as people evolve and this technology evolves, I think there may be a distribution of work. The operator would still be involved, and still would be in a controlling situation, and if

something went wrong, would be able to step in and take over control. But on the other hand, the more routine tasks could be offloaded to the devices.

SCENE 108

NARRATOR:

PERHAPS IN NO OTHER AREA DOES POKA-YOKE SHOW MORE PROMISE THAN WITH THE HANDICAPPED, A HUGE HUMAN RESOURCE THAT HAS GONE UNTAPPED BECAUSE OF ITS INABILITY TO WORK UNAIDED.

SCENE 109

ROBERT ERLANDSON

PROFESSOR

ELECTRICAL & COMPUTER ENGINEERING

WAYNE STATE UNIVERSITY

ERLANDSON ON-CAM (04:25:25 - 04:25:55)

The Americans with Disabilities Act created an interesting environment in terms of mandating that businesses cannot discriminate against an individual for a particular job based on a physical or cognitive disability, if they can perform the essential functions of the job with or without the aid of reasonable accommodation. It seems that poka-yoke would be the kind of device that could in fact provide that reasonable accommodation.

SCENE 110

NARRATOR:

IN ONE EXPERIMENTAL PROGRAM, DISADVANTAGED STUDENTS ATTEMPTED TO PERFORM AN ASSEMBLY OPERATION FOR A LOCAL MANUFACTURER. HOWEVER, PRODUCTION WAS A LOW EIGHTY-SIX PARTS PER HOUR AND THE ERROR RATE WAS FIFTY-TWO PERCENT.

SCENE 111

ERLANDSON ON-CAM (04:27:19 - 04:27:43)

One of our students designed a fixture for the clamp in the assembly process based on poka-yoke techniques, and with the use of that fixture, we found that all the students at the center that wanted to do this job could do it, which was a dramatic improvement. And also the students were now performing at about 186 parts per hour, which was more than adequate, and the error rate had dropped to less than 1 percent on the work they were doing.

SCENE 112

ERLANDSON ON-CAM (05:03:19 - 05:03:35)

I think a strong case is being made now that the poka-yoke process can in fact improve individuals' performance and not at additional cost, and it can do it in such a way that all the workers are performing at a higher rate.

SCENE 113

ERLANDSON ON-CAM (05:07:10 - 05:07:18)

There's a potential there for a win-win situation, for individuals with disabilities to be hired, and within the context of sound business principles.

-FTB-