MANUFACTURING INSIGHTS:

Poke-Yoke: Mistake Proofing

MUSIC UP AND UNDER

NARRATION (VO):

MANUFACTURING INSIGHTS,

MANUFACTURING ENGINEERING MAGAZINE'S VIDEO SERIES FOR PROCESS IMPROVEMENT.

NARRATION (VO):

THIS PROGRAM WILL EXAMINE MODERN METHODS OF POKE-YOKE, COMMONLY KNOWN AS MISTAKE-PROOFING – TECHNIQUES FOR PREVENTING MISTAKES, OR FOR MINIMIZING THEIR IMPACT.

FIRST, WE WILL INTRODUCE SOME CONCEPTS ESSENTIAL TO MISTAKE-PROOFING. THEN WE WILL INVESTIGATE HOW THE CONCEPTS ARE BEING PUT INTO PRACTICE...

...AT ESYS CORPORATION, AN ENGINEERING AND MANUFACTURING SYSTEMS INTEGRATION FIRM LOCATED IN AUBURN HILLS, MICHIGAN; A COMPANY WITH A SOLID UNDERSTANDING OF THE THEORY AND APPLICATION OF MISTAKE-PROOFING CONCEPTS.

...AT CONMED LINVATEC, WHERE A RANGE OF POKE-YOKE DEVICES HAS HELPED THEM BECOME A LEADER IN MEDICAL VIDEO SYSTEMS AND POWERED SURGICAL INSTRUMENTS.

...AND ALSO AT A SALINE, MICHIGAN PLASTICS PLANT, WHICH MANUFACTURES AND ASSEMBLES INSTRUMENT PANEL SYSTEMS. WE'LL SEE HOW MISTAKE-PROOFING IS BUILT DEEPLY INTO PROCESSES, ENABLING THEM TO SUPPORT THEIR CUSTOMER'S DEMANDING QUALITY AND DELIVERY REQUIREMENTS.

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NARRATION (VO):

IN ORDER FOR COMPANIES TO IMPROVE THEIR BUSINESS PROCESSES, THE ROOT CAUSES OF PROCESS PROBLEMS MUST BE SYSTEMATICALLY IDENTIFIED AND ADDRESSED. ONE OF THE MOST COMMON OF PROBLEM ROOT CAUSES IS THE MISTAKES THAT ARE FREQUENTLY MADE IN THE PRODUCTION OR DELIVERY OF GOODS OR SERVICES.

MISTAKE-PROOFING, ALSO KNOWN AS ERROR-PROOFING, IS SYNONYMOUS WITH THE JAPANESE TERM, POKE-YOKE. THESE NAMES ALL REFER TO THE SAME THING: METHODS THAT HELP AVOID PROCESS ERRORS.

TYPICALLY, REAL WORLD SITUATIONS HAVE MANY POTENTIAL FAILURE MODES. FOR EXAMPLE, WHEN AN AUTOMOBILE OR AN AIRCRAFT IS INVOLVED IN AN ACCIDENT, THERE MAY BE MANY POSSIBLE CONTRIBUTING FACTORS. THESE MAY INCLUDE WEATHER CONDITIONS, RANDOM MECHANICAL FAILURE, INADEQUATE PROCESSES, POOR EQUIPMENT DESIGN, OR OTHER REASONS. AMONG THESE REASONS, HOWEVER, ARE ERRORS MADE BY THE VEHICLE OPERATOR. INATTENTION, POOR JUDGMENT, OR INADEQUATE TRAINING CAN OFTEN LEAD TO MAJOR DISASTERS.

THESE TYPES OF FACTORS CAN ALSO INFLUENCE THE RESULTS OF BUSINESS PROCESSES. MISTAKES IN THE WORKPLACE CAN HAVE SERIOUS AND FAR-REACHING EFFECTS.

MISTAKE-PROOFING TECHNIQUES SUPPORT THE BUSINESS AND ITS CUSTOMERS IN SEVERAL WAYS. FIRST, THE REDUCTION OF WORKPLACE ERRORS REDUCES COST, INCREASES QUALITY, AND SPEEDS THE DELIVERY TO CUSTOMERS. THE RESULT IS STRONG PROCESSES THAT WORK RELIABLY, ARE MORE PREDICTABLE, ARE EASIER TO CONTROL AND SCHEDULE, AND THAT CAN WORK BETTER TOGETHER WITH OTHER PROCESSES IN THE BUSINESS. ALSO, THE DESIGN AND IMPLEMENTATION OF MISTAKE-PROOFING SUPPORTS COMPANY EFFORTS TOWARD CONTINUOUS IMPROVEMENT AND THE USE OF LEAN TOOLS AND PRINCIPLES.

TO BEGIN DEVELOPING EFFECTIVE MISTAKE-PROOFING TECHNIQUES, YOU MUST FIRST SEEK TO UNDERSTAND WHY MISTAKES HAPPEN IN THE FIRST PLACE. WHEN AN ACCIDENT OCCURS, INVESTIGATORS GO TO THE SCENE IN ORDER TO DETERMINE WHAT WENT WRONG, WHAT THE ROOT CAUSES WERE, AND HOW SIMILAR TYPES OF ACCIDENTS CAN BE PREVENTED IN THE FUTURE.

AS WITH THESE TYPES OF INCIDENTS, ERROR INVESTIGATIONS SHOULD BE CONDUCTED BY A CROSS-FUNCTIONAL TEAM. THE TEAM SHOULD INCLUDE SOME MEMBERS WITH DEEP KNOWLEDGE OF THE PROCESSES INVOLVED, ALONG WITH OTHER TEAM MEMBERS WHO CAN ADD INSIGHTS FROM OTHER PERSPECTIVES. OPERATORS INVOLVED WITH THE ERROR SHOULD ALSO BE A PART OF THE TEAM, SINCE THEY CAN OBVIOUSLY CONTRIBUTE FIRSTHAND ACCOUNTS OF WHY THE ERROR TOOK PLACE.

THE TEAM SHOULD GO TO THE PLACE WHERE ERRORS OCCUR, AND INVESTIGATE THE PROBLEM THOROUGHLY, MUCH LIKE A TEAM AT AN ACCIDENT, OR A CRASH SITE. IF POSSIBLE, THE TEAM SHOULD TRY TO OBSERVE ERRORS AS THEY OCCUR, OR BE ABLE TO RECONSTRUCT THE CONDITIONS UNDER WHICH THE ERRORS OCCURRED.

PYRAMID SOLUTIONS IS A COMPANY THAT DESIGNS, INSTALLS AND SUPPORTS MANUFACTURING EXECUTION SYSTEMS. GREG DEEL, ACCOUNT EXECUTIVE AND SYSTEMS ARCHITECT, DESCRIBES THE IMPORTANCE OF A DIVERSE, WELL-BALANCED MISTAKE-PROOFING TEAM:

GREG DEAL, ON CAMERA:

I think the most important thing to keep in mind is to make sure you've got a lot of different people involved in the solution. If you can brainstorm, if you have the mechanical engineers and the process folks in the same room, and then you begin discussing some possible solutions, invariably someone else is going to come up with another solution, and perhaps that is simpler than you would have thought of. We're in the software industry, so naturally we're going to lean toward some sort of complex software solution, but sometimes having even line workers involved will help you come to a more simple solution than you may have thought of on your own.

NARRATION (VO):

AT THIS POINT, IT IS ABSOLUTELY ESSENTIAL FOR THE TEAM NOT TO ASSIGN BLAME, BUT RATHER TO GATHER INFORMATION OBJECTIVELY AND TO UNDERSTAND PRECISELY WHY THE ERROR OCCURRED. FOCUS FIRST ON THE PROCESS, AND LAST ON THE PEOPLE.

THE TEAM NEXT NEEDS TO BRAINSTORM AND TO LOGICALLY ORGANIZE THE DATA GATHERED DURING THEIR INVESTIGATION. ONE COMMON METHOD FOR BRAINSTORMING AND ORGANIZING THE CAUSES OF MISTAKES IS WITH A FISHBONE OR ISHIKAWA DIAGRAM.

NARRATION (VO):

TO CREATE A FISHBONE DIAGRAM, ALL THE ELEMENTS OF A TYPICAL WORKPLACE ARE ARRANGED LIKE EACH OF THE BONES ON A FISH. THESE INCLUDE REASONS RELATED TO PEOPLE, WORKPLACE METHODS, MATERIALS, MEASUREMENT SYSTEMS AND EQUIPMENT, MACHINES OR TOOLS, AND THE WORKPLACE ENVIRONMENT. INFORMATION IS ALSO A COMMON SOURCE OF PROBLEMS, AND CAN BE ADDED, AS WELL. THE CENTRAL PROBLEM OR FOCUS OF THE BRAINSTORMING EFFORT IS PLACED WHERE THE HEAD OF THE FISH WOULD BE. TOGETHER, THE TEAM THEN USES THESE ELEMENTS TO BRAINSTORM THE FACTORS CONTRIBUTING TO THE ERROR.

NARRATION (VO):

ANOTHER HELPFUL APPROACH TO USE AT THIS POINT IS THE CALLED FIVE WHYS TECHNIQUE. USING THIS METHOD, THE TEAM REPEATEDLY ASKS WHY A PROBLEM OCCURRED. EACH TIME, A DEEPER CONTRIBUTING CAUSE OF THE PROBLEM IS REVEALED ALONG A CHAIN OF REASONING. EVENTUALLY, THIS LEADS TO A TRUE ROOT CAUSE WHICH, WHEN SOLVED, BREAKS THE CHAIN THAT LED TO THE SURFACE-LEVEL PROBLEM. TOGETHER, THE FISHBONE DIAGRAM AND THE FIVE WHYS TECHNIQUE ARE POWERFUL TOOLS FOR ANY MISTAKE-PROOFING TEAM.

NARRATION (VO):

TO SUPPORT THE NEXT STEPS OF MISTAKE-PROOFING, TEAMS SHOULD DESCRIBE THE ROOT CAUSES OF ERRORS AS SIMPLY AS POSSIBLE. GENERALLY, TEAMS WILL DISCOVER THAT THESE ROOT CAUSES ARE THAT SOMETHING WAS EITHER MISSING, OR THAT IT WAS INCORRECT OR INADEQUATE FOR THE INTENDED PURPOSE.

NARRATION (VO):

FOR EXAMPLE, ERRORS MAY HAVE OCCURRED BECAUSE A SPECIFIC STEP WAS LEFT OUT OF THE PROCESS SEQUENCE, BECAUSE THE INCORRECT MATERIAL USED IN MAKING A PRODUCT, OR THAT THE MEASUREMENT TOOL PROVIDED FOR THE OPERATOR WAS NOT ADEQUATE FOR THE REQUIREMENTS OF THE PRODUCT SPECIFICATION.

NARRATION (VO):

WHEN THE ROOT CAUSES OF THE ERROR HAVE BEEN IDENTIFIED AND LABELED, THE TEAM CAN MOVE FORWARD TO THE INNOVATIVE AND MOST CHALLENGING STEP: DEVELOPING MISTAKE-PROOFING COUNTERMEASURES. COUNTERMEASURES ARE THE TECHNIQUES AND STRATEGIES FOR ELIMINATING OR MINIMIZING THE FREQUENCY OR IMPACT OF MISTAKES. THEY CAN TAKE MANY FORMS, AND THE BEST COUNTERMEASURES ARE SIMPLE, ROBUST, AND INNOVATIVE.

NARRATION (VO):

MISTAKE-PROOFING COUNTERMEASURES CAN BE DESIGNED AROUND SIX DIFFERENT STRATEGIES THAT RESULT FROM THE COMBINATION OF TWO DIFFERENT FACTORS: THE STATE, AND THE ACTION TAKEN. THE STATE DESCRIBES WHETHER AN ERROR IS ABOUT TO OCCUR, OR WHETHER IT HAS ALREADY OCCURRED AT SOME TIME IN THE PAST.

NARRATION (VO):

THE ACTION TAKEN DESCRIBES HOW THE POKE-YOKE TECHNIQUE OPERATES: EITHER BY ERROR INDICATION, POINTING OUT THAT AN ERROR HAS OCCURRED; ERROR CONTROL, LIMITING THE OPERATION FROM PROCEEDING INCORRECTLY, THEREBY PREVENTING THE ERROR; OR BY PROCESS SHUTDOWN, PREVENTING THE PROCESS FROM GOING FORWARD.

NARRATION (VO):

TOGETHER, THE TWO POSSIBLE STATES AND THREE POSSIBLE WAYS IN WHICH MISTAKE-PROOFING CAN OPERATE PROVIDE FOR SIX DIFFERENT POSSIBILITIES FOR TEAMS TO EXPLORE AS A MEANS OF PUTTING MISTAKE-PROOFING TO WORK.

NARRATION (VO):

WHETHER THE MISTAKE WE ARE TRYING TO PREVENT IS ON THE FACTORY FLOOR, IN AN OFFICE ENVIRONMENT, OR SIMPLY IN OUR DAILY LIVES, EXAMPLES OF MISTAKE-PROOFING TECHNIQUES ARE EVERYWHERE AROUND US.

NARRATION V.O.:

INDICATORS ARE OFTEN USED TO HIGHLIGHT ERRORS BEFORE THEY OCCUR. FOR INSTANCE, THE “CHECK ENGINE” WARNS US OF TROUBLE BEFORE ENGINE DAMAGE OCCURS,

A SMOKE DETECTOR ALARM LETS PEOPLE KNOW THAT THEY SHOULD EVACUATE A BUILDING BEFORE THE SITUATION BECOMES LIFE THREATEN,

WHILE COMPUTER LOGIC CAN BE PROGRAMMED TO CHECK THAT ALL FORMS ARE FILLED IN CORRECTLY BEFORE THE DATA IS TRANSMITTED.

AN EXAMPLE OF ERROR CONTROLS ARE SAFETY LOCKS SUCH AS CHILDPROOF CAPS ON MEDICATIONS THAT PREVENT CHILDREN FROM MISTAKENLY TAKING MEDIATION,

OR FAILSAFE POINTS SUCH A DRAIN HOLE AT THE TOP OF THE SINK PREVENTS RUNNING WATER FROM OVERFLOWING.

OR A AUTOMATIC BRAKE WHICH PREVENTS A CIRCULAR SAW FROM CUTTING INTO A WORKERS FINGER.

NARRATION (VO):

CLEARLY, FROM THESE EXAMPLES, THERE ARE MANY POSSIBLE WAYS A TEAM CAN PUT POKE-YOKE METHODS TO WORK. THINKING WITHIN THE FRAMEWORK OF WHETHER ACTION OCCURS BEFORE OR AFTER THE ERROR, AND THE TYPE OF ACTION TAKEN CAN HELP GROUPS DESIGN MISTAKE-PROOFING METHODS THAT ARE SIMPLE, INNOVATIVE, AND EFFECTIVE.

--- TOUCH BLACK ---

NARRATOR V.O.:

ESYS CORPORATION, LOCATED IN AUBURN HILLS MICHIGAN, SPECIALIZES IN AUTOMATION CONTROLS FOR DATA COLLECTION, ERROR-PROOFING, AND TRACEABILITY. MANY OF THE COMPANY’S MISTAKE-PROOFING SOLUTIONS ARE DESIGNED TO ADDRESS ERRORS THAT COMMONLY OCCUR WITH MANUAL ASSEMBLY.

Bayan:

When you perform a repetitive operation over and over, what happens is after a while you tend to make mistakes. What they have done as far as experiments, they have had the operator that was supposed to pick only two parts, one red and one green, to have for the first part of the morning only red parts. When they asked him to intermittently pick the green parts in the afternoon, they made a mistake and picked only red parts. So people get conditioned, and the part of the brain that involves learning and paying attention, after you do something repetitively, it shuts down and you basically just go and grab stuff and put it on the system. This way we're actually helping the operators to get conditioned.

Bayan:

Overall, when repetitive work is performed by a person, mistakes are bound to happen according to Shingo and the pillars of zero quality control. They're bound to happen. What we do here is just cue the operator and show them what they're supposed to pick, and basically condition them or jog their memory as far as the actual part that is supposed to be picked in real time for assembly.

NARRATOR V.O.:

PICK-TO-LIGHT SYSTEMS, LIKE THOSE DEVELOPED BY ESYS, ARE A COMMON METHOD OF INDICATING AN ERROR BEFORE IT OCCURS, IN THIS CASE, SELECTING AND INSTALLING THE INCORRECT PART. ALTHOUGH THE COMPANY MAKES A NUMBER OF TECHNOLOGICALLY ADVANCED SYSTEMS, ESYS DEMONSTRATES THAT POKE-YOKE METHODS DO NOT REQUIRE HIGH TECHNOLOGY, OR BIG BUDGETS. FOR EXAMPLE, ESYS INCORPORATES MISTAKE-PROOFING WHEREVER POSSIBLE IN THE DESIGN OF ITS OWN PRODUCTS.

Bayan:

What we have done on E-System Mistake Proofing System is we also have mistake-proofed the connectors and connections to floor devices and higher level systems. Meaning you cannot use the power connector on any one of the other connectors that are here.

NARRATOR V.O.:

COMPANIES LIKE ESYS CORPORATION HELP THEIR CLIENTS APPLY MISTAKE-PROOFING CONCEPTS AND TECHNIQUES THAT LIMIT WORKPLACE ERRORS AND ENSURE TOP QUALITY, AT LOWEST COST, DELIVERED ON TIME.

--- TOUCH BLACK ---

NARRATOR V.O.:

NEXT, WE VISIT CONMED LINVATEC, HEADQUARTERED IN LARGO FLORIDA, WHICH IS A GLOBAL LEADER IN THE FIELDS OF ARTHROSCOPY PRODUCTS CONSISTING OF MINIMALLY INVASIVE MEDICAL DEVICES, SPORTS MEDICINE INSTRUMENTS AND IMPLANTS, SURGICAL VIDEO SYSTEMS AND POWERED SURGICAL INSTRUMENTS. THE COMPANY'S PRODUCTS ARE USED TO PERFORM ADVANCED SURGERY PROCEDURES, AND THE DEMANDING PRODUCT SPECIFICATIONS REQUIRE THAT THE COMPANY GETS QUALITY RIGHT THE FIRST TIME. MISTAKE-PROOFING PLAYS A KEY ROLE IN THE COMPANY'S SUCCESS AND EXAMPLES CAN BE FOUND IN ALL AREAS OF THE BUSINESS.

NARRATOR V.O.:

MANY OF CONMED LINVATEC'S MISTAKE-PROOFING MECHANISMS ARE DESIGNED TO SUSTAIN THE COMPANY'S STERILE MANUFACTURING CONDITIONS – AN ENVIRONMENT WHERE NO COMPROMISES CAN BE ACCEPTED. THEREFORE, IF CONDITIONS EXIST THAT CAN AFFECT CLEANLINESS; IT IS ABSOLUTELY NECESSARY THAT THE OPERATIONS BE SHUT DOWN BEFORE ANY CONTAMINATION CAN OCCUR.

BILL MAZUREK, CONMED LINVATEC'S CONTINUOUS IMPROVEMENT CHAMPION EXPLAINS:

Mazurek:

About 80% of our products here are gone through a sterile environment. So everything has to be going through a sterile packaging arena, which is the clean environment or portable clean room. As a result of that, we have to maintain certain particulate level. If we're not maintaining that particulate level, you could get fibers or particles inside a sterile package, and as a result, it would fail our requirements and you could pass on something that would be non-sterile to the field after we through our sterilization processes.

Mazurek:

Any time you open any of the back doors, or you have any feeding of parts into the environment, basically there are certain alarms and alerts that go off. We also have to maintain the amount of pressure that's inside the chamber at all times. If the pressure varies, basically the packaging station and everything shuts down in unison.

Mazurek:

The operational interlocks, they're basically control switches that if a door opens up, and there is a time associated with that, so if a door opens up greater than 10 seconds, basically the whole unit shuts down. It gives us an open window to feed parts in the back up portable clean environment, but by the same token, if those interlocks aren't working properly, it just shuts down. Another example is in our clean room, we actually have three doors that go into the clean room area that all interlock together. If one of the door is open, the other doors will not open. They're actually a magnet-type control, so the interlocks prevent more than one door opening so we won't contaminate the work environment.

NARRATOR V.O.:

MANY OF CONMED LINVATEC'S MISTAKE-PROOFING SYSTEMS ARE INDICATORS THAT ACTIVATE EITHER BEFORE AN ERROR HAS OCCURRED, OR IMMEDIATELY AFTER. LIKE MANY COMPANIES, CONMED LINVATEC USES ANDON LIGHTS TO INDICATE THE CURRENT STATUS OF A PROCESS AT A GLANCE. ANDON LIGHTS HELP INSURE THE PROCESS IS PRODUCING PRODUCTS TO SPECIFICATION WHILE PROVIDING CONSTANT FEEDBACK TO THE OPERATORS. VISUAL REAL TIME FEEDBACK IS A CRITICAL PART OF MISTAKE PROOFING FOR CONMED LINVATEC.

Mazurek:

We've got this andon board outside of our molding factory, and it gives us the exact status of every piece of equipment that is running. If you see all green lights out there, basically everything is running properly. A yellow light, typically there is a setup going on, or a red light means there's a shutdown for some planned maintenance or just the equipment is shut down for some reason. So it gives us a quick visual to find out what's happening in the department. Yellow lights basically give the engineers and process owners an opportunity to go see what's happening. Shutdowns also, the same in regards to that.

Mazurek:

We have a packaging cell that we have andon devices within the cell, and it gives us a visual indicator if something is going wrong within the process. If any of our processes are out of control or they're being shut down, we'll go to a yellow or red light situation.

NARRATOR V.O.:

AS DESCRIBED EARLIER, ONE EFFECTIVE MISTAKE-PROOFING STRATEGY IS TO CONTROL THE PROCESS IN A MANNER THAT MAKES IT DIFFICULT OR IMPOSSIBLE FOR AN OPERATOR TO PERFORM THE OPERATION IN AN INCORRECT MANNER. AT CONMED LINVATEC, PRODUCT LABELING IS CONSIDERED A CRITICAL FEATURE, AND THE PROCESS IS EFFECTIVELY MISTAKE-PROOFED.

Mazurek:

The shaver blade labeling fixture that we have implemented as our mistake-proofing device actually aligns where the label goes. It's a very simple fixture that when we put the label in front of it, literally the operator has to put the label within that sweet spot. It's an alignment fixture that actually helps the operator put the fixture right on top of the blister and marks our blisters and boxes that way.

NARRATOR V.O.:

ANOTHER EXAMPLE OF CONTROLLING ERRORS BEFORE THEY OCCUR IS PROVIDED IN THE COMPANY'S POUCH PACKAGING OPERATION.

Mazurek:

Our pouch packaging is another example from one of our poke-yokes that actually prevents a defect. We have some sensors in the back of our pouch equipment when we're doing our sealing. We have to bring it into a sensor, and once it hits that sensors it will go through the sealing properly. If it doesn't hit the sensor correctly, or if we pull away from the sensor, basically the unit shuts down. It will not seal, it will not allow that package to be sealed. The heat starts to actually deflect and it will actually start curling the polybag at that point in time. It's 100% error proof. It will not produce a defective product.

NARRATOR V.O.:

SOMETIMES, SHUTTING DOWN THE PROCESS IS THE MOST EFFECTIVE WAY TO ENSURE THAT AN ERROR CANNOT BE PASSED ON TO THE NEXT OPERATION OR TO THE FINAL CUSTOMER. HERE AGAIN, CONMED LINVATEC EXCELS IN THE USE OF THIS ROBUST TECHNIQUE.

Mazurek:

Before, typically when you buy a piece of equipment from any of these outside sealers, there is not that level of sophistication. There are time, temperature, pressure controls that are manual. It was up to the operator to assess those to a preset and just run the equipment. Here we were having errors in providing the sweet spot consistently to the operator, and as a result of those errors being produced, that’s when we added the sensors. So we did a lot of integration in our own tool room to provide the sophistication we needed to provide this detection for us.

NARRATOR V.O.:

ONE MANUFACTURING AREA WITHIN THE COMPANY DEMONSTRATES HOW ERRORS CAN FIRST BE HIGHLIGHTED FOR EARLY INTERVENTION, AND, IF NO ACTION IS TAKEN, THE ERROR-PROOFING TECHNIQUE ESCALATES TO SHUT DOWN THE PROCESS BEFORE SERIOUS HARM CAN RESULT.

Mazurek:

Another good example is in our shaver blade factory. We've got some andons that are built into our steam cleaners. The steam cleaners themselves are actually producing waste water as a result of running our steam cleaners. Prior to developing this andon device, we waited for the material or waste water to get to a certain level and it was always somebody's responsibility to make sure it was changed. We were always running into vacs, overflows etc. Now we have a set point that when it gets ¾ full there is a light that goes off. It goes from no light to yellow to red. The yellow light gives us an indication that it is getting full, and beyond the full point then it turns into red, and it will basically shut down the operation. So the burden is hopefully our water spiders will remove the waste water and bring in an empty bucket and dispose of it properly.

NARRATOR V.O.:

IN CERTAIN CIRCUMSTANCES WHERE AN ERROR DOES OCCUR, THE PROCESS CAN BE SHUT DOWN TO PREVENT PROBLEMS FROM PROPAGATING.

Mazurek:

The shaver blade magnet fixture is one of those example… we have a shaver blade that has blade recognition. We can put a magnet at either a 12, 3, 6 or 9 o'clock set point. Prior to implementing our poke-yokes or mistake-proofing devices, the operator could actually rotate the plastic member and actually put the magnet in the wrong location. Now we have a methodology that a water spider actually sets it on the back of the machine to a set point, and once it's set it's totally mistake-proof. You cannot put a magnet in the wrong location. If you do by mistake, the whole device shuts down and will not pass the part along to the next station. So once its set up you can't rotate it, and if it is rotated incorrectly, the machine will grab on to it and won't release it. The water spider has to come over and release it and zero the machine out and rest it. Then we know that's a defective part.

NARRATOR V.O.:

CONMED LINVATEC TAKES A SYSTEMATIC, CUSTOMER-FOCUSED APPROACH TO THE DEVELOPMENT OF MISTAKE-PROOFING DEVICES. TOOLS SUCH AS FAILURE MODES AND EFFECTS ANALYSIS, OR FMEA, PLAY A CENTRAL ROLE.

Mazurek:

We try to understand what our customer requirements are. The customer requirements typically are engineering specifications. We drive that, as our first step, into a process map. Through that process mapping technique we understand the process where it needs to be. Then we actually develop a process FMEA. The process FMEA really focuses on the material going through that process, the operator, and the equipment itself. And through that result, we start zeroing in on what is critical. Operator dependency, if we're really concerned about the operator intervention, if the operator can either damage or corrupt the product, then typically that's a good example for a mistake-proofing device to be engineered. Once we develop that methodology and start going through our process FMEA, we literally start going through our detection, our occurrence, the severity of the issue, and we dissipate that down into some type of corrective action plan. That is typically designing a fixture. We get the tool room together, we have a tool room on staff, and basically we go through a concept development where we take design alternatives and we say how can we prevent this issue from occurring. As a result of developing through that we hopefully come up with our best solution that's going to mitigate that risk from occurring forward. Our engineering department, we spec and we develop or calibrate it, and we release it out to the shop at that point.

NARRATOR V.O.:

AS WITH OTHER COMPANIES WITH DEEP EXPERIENCE WITH MISTAKE-PROOFING, CONMED LINVATEC UNDERSTANDS THAT MISTAKE-PROOFING IS MORE THAN MERELY TECHNICAL COUNTERMEASURES – IT IS A PROCESS IMPROVEMENT PHILOSOPHY THAT INVOLVES SAFEGUARDS AND TOOLS TO ENSURE THAT ONLY PERFECT PRODUCT IS PRODUCED OR SENT ON TO THE CUSTOMER.

Mazurek:

I think mistake-proofing today, the advice I would give any company is start off simple and start off small. A lot of the operator interventions, go out and understand the shop floor, understand the slight nuances, make sure your processes are stable and under control. Really understand what his operator dependencies are. If the operator dependency is critical to the quality of your product, that gives you a good opportunity to start.

NARRATOR V.O.:

CUSTOMERS BOTH INTERNAL AND EXTERNAL RELY ON CONMED LINVATEC'S MISTAKE-PROOFING METHODS. THEY HAVE BECOME AN INTEGRAL PART IN HOW THE COMPANY SATISFIES BOTH MARKETPLACE AND EMPLOYEE REQUIREMENTS.

Mazurek:

Our reaction from our customers and internal and external to our mistake-proofing. In some cases it's invisible to our external customers. But from an internal standpoint, our one-piece flow methodology, we've got inventory reduction, we've got responsiveness, we've got all those things we're working through as a company. As a result of that, our customers are certainly more happy. We have to ship certain products within 24 hours. Our response rates, our delivery rates, etc., are supporting that. When you have high defects, you can't insure your processes are stable and in control, and our pokeoke and mistake-proofing devices are really helping that methodology. If you can't do that, then typically you end up with more inventory, it could be a higher skilled workforce, you have to bring more training and education into the process. Because the less you can do that, the more you can push down the simplicity of the methods through poke-yoke, you can train people faster, quicker, better, and get it to the field faster. Our internal customers love it. Our external customers, hopefully they understand the responsiveness and our supply chain and our stability to ship products real time within 24 hours, and hopefully they see that and sense that through our mistake-proofing activities and devices.

NARRATOR V.O.:

MISTAKE-PROOFING TECHNIQUES ARE AN ESSENTIAL INGREDIENT TO THE COMPANY'S DEPLOYMENT OF LEAN MANUFACTURING, AND IT HAS RESULTED IN SOME DRAMATIC BOTTOM LINE BENEFITS.

Makurk:

When you measure the performance of our shaver blade factory, literally we're more responsive. If you compare us from five years ago to right now, our back orders are down by about 50 percent today. Literally we're much more responsive. Ninety-eight percent of our product ships within 24 hours. In the days past, it was in the low 90 percent range. We have a lot more affectivity, we have a lot less scrap. Our scrap rate is reduced by 20 to 25 percent in some areas as a result of our mistake-proofing activities.

-- TOUCH TO BLACK --

NARRATOR V.O.:

THE SALINE PLASTICS PLANT IN SALINE MICHIGAN PROVIDES A WIDE RANGE OF INSTRUMENT PANEL SYSTEMS TO ELEVEN DIFFERENT CUSTOMER SITES WITHIN THE FORD MOTOR COMPANY. THE PLANT BUILDS FOR DEALER STOCK, AS WELL AS TO SPECIFIC CUSTOMER ORDERS. ALL DASHBOARD COMPONENTS ARE ASSEMBLED AT SALINE PER THE SPECIFIC PRODUCT REQUIREMENT AND ARE DELIVERED ON A JUST-IN-TIME BASIS TO THE FORD ASSEMBLY LINES IN EXACTLY THE ORDER THE CARS ARE BEING BUILT. WITH THE HIGH DEGREE OF CUSTOMIZATION AVAILABLE TO END CUSTOMERS, THE SALINE PLANT HAS WELL OVER 1500 INDIVIDUAL END ITEMS PER CAR LINE THAT THAT THEY HAVE TO CONTROL. CLEARLY, OPPORTUNITIES FOR MISTAKES ARE HIGH, AND MISTAKE-PROOFING TECHNIQUES ARE CRITICAL TO THE COMPANY'S SUCCESS. BRUCE VERBURG, PLANT MANAGER OF THE SALINE PLASTICS PLANT, EXPLAINS.

Verburg:

We have a number of different features that go into an instrument panel. On a typical IP we have 34 features, which includes the wire harness, the airbag, the radios, all the things that a customer can choose. Those features then have roughly, as minimal as two different types of that feature to as many as 40 different types of that feature. So we use the mistake-proofing to be able to differentiate the different types and be sure they go into a specific order into the customer-driven order for the instrument panel.

NARRATOR V.O.:

MAKING SUBASSEMBLIES AT SUPPLIER LOCATIONS IN THE ORDER THEY WILL BE USED, AND DELIVERING THOSE MATERIALS IN SMALL BATCHES, IS KNOWN AMONG FORD AND ITS SUPPLIERS AS IN-LINE VEHICLE SEQUENCING, OR I.L.V.S. CLEARLY, WITH THE WIDE RANGE OF CONSUMER CHOICE AND THE SMALL MARGIN FOR ERROR IN FORD'S JUST-IN-TIME PRODUCTION ENVIRONMENT, MISTAKE-PROOFING IS A CENTRAL ELEMENT OF THE COMPANY'S LONG-TERM STRATEGY.

Verburg:

Mistake-proofing is part of the culture in the Saline plant, and it has developed over years. We worked hand in hand with a software development company to bring out different aspects of our needs that were different than the marketplace. We build ILVS instrument panels, and that started in the mid-1990s, and that allowed us to have feature-based releases to customer requirements. The software company and Saline worked together to be able to control the complexity to match the customer wants, and that has evolved over the last 15 years to be a system now that not only controls how we sequence the parts, it ties in our error-proofing for torques, for our rotations to be sure all the screws are torqued all the way down, to be sure the right feature was picked, to remind operators that the right components were installed. When an operator has a repair, that is also tracked through that same software, so that a defect does not get out to the customer. That has improved our quality substantially over the last 10 years.

NARRATOR V.O.:

SALINE PLASTICS HAS EMBEDDED NUMEROUS MISTAKE-PROOFING DEVICES INTO THEIR PRODUCTION PROCESSES. THE PROCESS OF KITTING AND ASSEMBLING INSTRUMENT PANELS IS A PRIME EXAMPLE.

Verburg:

The very start of our process begins with a customer order that is basically put on a sheet of paper like you would have when you go to the grocery store. It has different tic marks for what is required for that specific order. It's controlled by a bar code scanning system. An operator, at the beginning of the shift, will scan that check sheet to make sure they have the right one started up, and then it will light up a series of lights. It basically is the start of the error-proofing system. Lights will go on in different bins, and the operator will go and grab parts out of those bins and put it into an individual kit, or tote, for the line. That will be the start of the instrument panel as it gets loaded onto the line. In that kit will be all the high-complexity specific parts that need to be built on the line. Things of lower complexity, where it could only be this one, or maybe one of two, something we would leave up to an operator, we don't kit those because there's no need to. But things with a lot of variety we put into the kit boxes, and then we marry them to the base crosscar beam and the panel.

Verburg:

The kit lights go on that show the correct part to be put into the kit. If the operator should make a mistake and grab it out of the wrong bin, a light curtain is energized with the breaking of the beams, and a horn goes off that says basically, you picked the wrong part. It's just an alarm that says you went to the wrong area. If you go to the right area, of course, there is no alarm.

Verburg:

Once the kit is completed, we marry it to the wire harness, and what we call the substrate, which is the covering for the IP, what you see as the dashboard in your vehicle. We marry it using computer systems and bar code labels to marry that kit to the wire harness to the car's substrate, to make sure we built the two or three major components correctly. After that we use the same computer systems to make sure we're putting things in the proper sequences and orders. They have the operator process sheets up on the boards, up on the screen, so the operators can follow the process. It will also remind operators, if you have a low take rate… I need a GPS antenna in this one and they may have not put it in the last ten vehicles, but they need to put it into this one, so it will actually call out with an audible horn that says, "don't forget to put in the GPS antenna." If they don't acknowledge it on the keyboard, the line will stop to make sure it gets put in. It's a way of mistake-proofing to make sure the part gets added if there is no other way of error-proofing in the system. We have DC drivers on the lines. The DC drivers control torque, they control torque as well as we count the revolutions. If we don't have the proper number of revolutions on the screw and then reach torque, it could torque out early and cause a squeak and rattle in the end customer's vehicle.

NARRATOR V.O.:

SALINE'S MISTAKE-PROOFING DEVICES CAN BE FOUND IN NEARLY ALL PRODUCTION AREAS. IN THE COMPANY'S INJECTION MOLDING AREA, SENSORS ARE ABLE TO ALERT SUPERVISORS WHEN ERRORS OCCUR.

Verburg:

The technology for injection molding, the simple grabbing of resin, melting it down, and shooting it into a part, has not changed over the course of 40 or 50 years. The systems are relatively the same. However, technology has taken us to a different level of ability to monitor, to control, and to basically influence the injection molding process. Here in Saline we use our error-proofing methodologies to incorporate that into our injection molding process. We install sensors into the tools to be able to check for end of part fills, for pressure, for temperatures, to make sure we control the processes that makes a good part every time. Through that control and feedback mechanism, we have been able to improve cycle times and reduce part waits, which overall makes us efficient and more competitive.

NARRATOR V.O.:

IN ANOTHER AREA, INSTRUMENT PANELS ARE ROBOTICALLY SCORED TO ALLOW AIRBAGS TO DEPLOY WHILE STILL MAINTAINING THE SEAMLESS, STREAMLINED INTERIORS AUTOMOBILE CUSTOMERS DEMAND. THE LOCATION AND DEPTH OF THE SCORE LINE MUST BE CONTROLLED PRECISELY TO PRODUCE THE DESIRED RESULT. IN THE SALINE FACTORY, POKE-YOKE ENSURES THAT REJECTED PARTS CANNOT POSSIBLY AFFECT CUSTOMER SAFETY.

Verburg:

In our laser scoring cell, it is critical that our mistake-proofing pick up bad scoring cuts. It’s a series of holes that are drilled around the airbag opening to allow the airbag to deploy properly. If one of those thousands of holes is not to the right depth or is in the wrong orientation, the computer system will log that problem, and at the end of the cuts, it cuts out a big hole so it could not possibly be made through the assembly system further on down the line. It gives the operator feedback that it is not a good part.

NARRATOR V.O.:

AT THE SALINE PLASTICS FACILITY, ALL EMPLOYEES HAVE BEEN DEEPLY INVOLVED IN THE DESIGN, IMPLEMENTATION, AND CONTINUOUS IMPROVEMENT OF THE COMPANY'S MANY MISTAKE-PROOFING DEVICES. THEY HAVE BECOME AN ACCEPTED AND NECESSARY ELEMENT IN HELPING SALINE TO ACHIEVE EVER-HIGHER LEVELS OF CUSTOMER SATISFACTION.

Verburg:

The responsibility for continuing to improve is everyone's. It isn't just one person; it's everyone in this facility. From the hourly person who puts the screws into the panel, to the person who fills the kits, to the engineer who designs the process, to the management team who helps give them everything they need in order to make a good part. It's not just one person's job to worry about quality, it's everybody's.

Verburg:

Because mistake-proofing is part of our culture, it started in the salary ranks, and it moved into the hourly ranks years ago. Now they're starting to want that mistake-proofing, they rely on that mistake-proofing. Operators make mistakes, people make mistakes all the time. They don't mean to, but with the repetitive nature of our jobs, they need that little bit extra to help them. And quite frankly, the customer demands flawless execution of the manufacturing process. So the mistake-proofing is demanded out on the manufacturing floor, and it's well received. There are a couple times when operators don't have that mistake-proofing, where a defect does get to the final customer, and they'll say "we can do it this way to make sure it never happens again." Everything can be improved upon, and we incorporate those changes in our process to drive down our defects.

NARRATOR V.O.:

SALINE PLASTICS HAS DEVELOPED AN EFFECTIVE APPROACH TO MISTAKE-PROOFING. NOT EVERY COMPANY WILL FOLLOW THIS SAME STRATEGY. FOR OTHER ORGANIZATIONS LOOKING TO GET STARTED WITH MISTAKE-PROOFING, BRUCE OFFERS SOME ADVICE FROM SALINE PLASTICS'S EXPERIENCES.

Verburg:

There is no quick fix to mistake-proofing and error-proofing. You have to start from the basics. If you try to fix everything all at once, you are doomed to failure. You'll have so many complicated things out there. So what you do, you start and determine what you minimally need to do, what the most cost efficient thing is that you can afford, and start growing from there.

NARRATOR V.O.:

SALINE UNDERSTANDS HOW POKE-YOKE METHODS SUPPORT THEIR EFFORTS TO BECOME A COMPETITIVE LEAN COMPANY. MISTAKE-PROOFING HAS DELIVERED SUBSTANTIAL BOTTOM LINE BUSINESS RESULTS, AND HAS HELPED THE COMPANY SURVIVE AND THRIVE IN A CHALLENGING MARKET.

Verburg:

Lean is all about eliminating waste. So if you can give a person a very consistent part or a very consistent process, you eliminate that waste. So the technologies we've been talking about give a very consistent quality part to the next process, and that's what Lean is all about.

Verburg:

Utilizing all these technologies in the plant for mistake-proofing, error-proofing, and the control feedback systems, we have been able to achieve double-digit improvements in quality at our end customer, we have been able to have double digit improvements in material weight savings in injection molding, as well as improvement in cycle times in the double digit range as well.

-- TOUCH TO BLACK --

NARRATOR V.O.:

IN THIS VIDEO, WE HAVE SEEN HOW POKE-YOKE, ALSO KNOWN AS MISTAKE-PROOFING, DELIVERS IMPORTANT CUSTOMER AND BUSINESS BENEFITS, INCLUDING IMPROVED SAFETY, REDUCED VARIABILITY, HIGHER QUALITY, AND REDUCED COST THROUGH THE ELIMINATION OF WORKPLACE ERRORS. THE OPPORTUNITIES FOR ELIMINATING ERRORS ARE VIRTUALLY LIMITLESS, AND WE HAVE SEEN POKE-YOKE METHODS IN SIX DIFFERENT CATEGORIES DEMONSTRATED IN THREE SUCCESSFUL AND FORWARD-THINKING COMPANIES. MISTAKE-PROOFING IS AN IMPORTANT TOOL THAT CAN HELP BUILD THE FOUNDATIONS FOR BUSINESS SUCCESS.

-- FADE TO BLACK --

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