240 Poka-yoke Examples

Poka-yoke eliminates waste in operations and complaints from consumers, and creates a profitable factory. The 240 examples of poka-yoke that follow were collected from more than 100 companies in 10 different industries, including electronics, automobiles, cameras, and heavy industry.

Processing Errors

• *Example 1*

Process: Series of operations performed by one worker

Problem: Omitted processing

Solution: Interlock operations

Prevent Error:

Detect Error: X

Shutdown: X

Control:

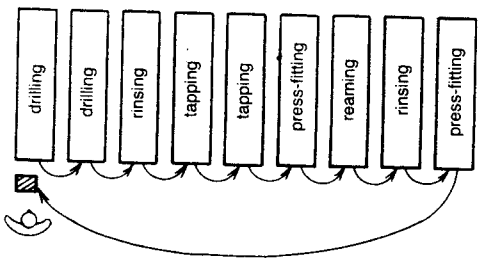
Alarm: X

Key Improvement: Process will not start if preceding operation is omitted

Description of Process: One operator performs several different operations, including drilling, tapping, press-fitting, and rinsing, in round-robin fashion on nine machines.

Before Improvement:

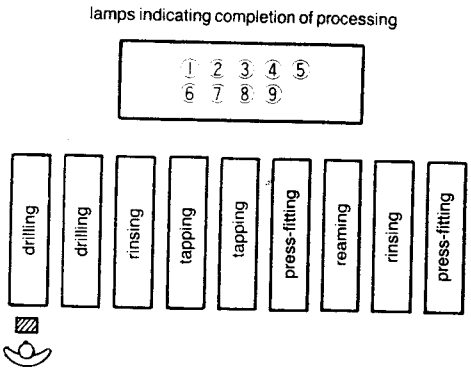
Because of the complexity of the line, newly assigned workers often did not fully understand the requirements of the work. Some unprocessed items were passed to the next operation because the operator had forgotten to press a start-up switch along the line. The unprocessed items numbered two or three a day.



After Improvement:

The switches for the different operations were interlocked to make it impossible to start a new round of processing if any of the operations in the preceding round has been omitted. In addition, as each operation is started, a corresponding lamp is lit on a panel. After one cycle is finished, the worker returns to the first operation to begin a new cycle of processing. If no operations have been skipped, the switch for the first operation is not locked, and the operator can begin a new cycle. However, if an operation has been omitted, the switch for the first operation is locked. The operator observes the lamps to determine which operation has been skipped. (A skipped operation turns on a buzzer and a rotating warning light.)

The worker then goes to the operation for which the lamp is not lit, switches that machine onto a manual circuit, and performs that operation alone. When the operation is finished, the worker resets the machine to the automatic circuit and starts the first operation in the series.



• *Example 2*

Process: Tapping

Problem: Holes not tapped, or not tapped to proper depth

Solution: Limit switches detect tapping depth errors

Prevent Error:

Detect Error: X

Shutdown: X

Control:

Alarm: X

Key Improvement: Tool modified to guarantee correct processing

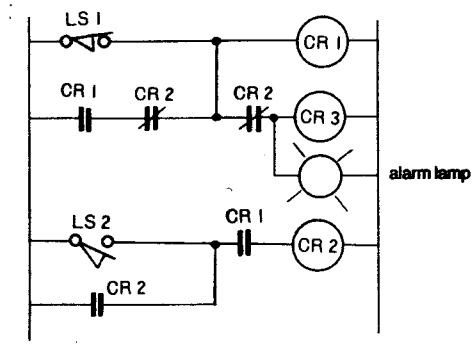
Description of Process: Deep (38 mm) holes are tapped in high carbon steel.

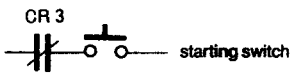
Before Improvement:

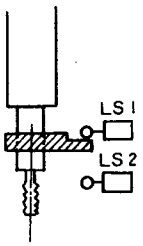
The tap was driven to the desired depth in one operation. However, the hard material and extreme tapping depth caused the clutch of the machine to slip if the tap was slightly worn, and tapping stopped before the hole had been tapped to the required depth. The operator was unable to detect this defect.

After Improvement:

Limit switches were mounted at the front and back of the tapping machine's main shaft, enabling the operator to check the movement of the shaft. If the main shaft does not go down to the prescribed depth, a blinking red lamp comes on to alert the operator. The machine cannot be started again until the operator has dealt with the defective workpiece and cleared the error.







● *Example 3*

Process: Drilling **Prevent Error:** X **Shutdown:**

Problem: Workpiece set into jig incorrectly **Detect Error:** **Control:** X

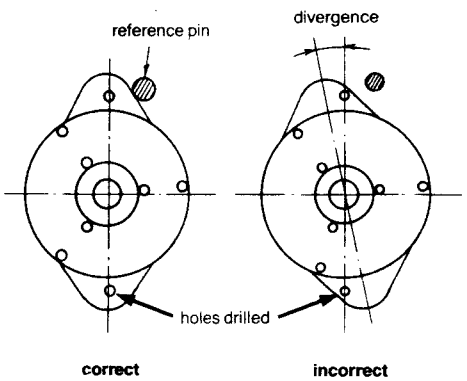
Solution: Use air cylinder to position workpiece **Alarm:**

Key Improvement: Jig modified to guarantee correct positioning

Description of Process: A workpiece is placed in a jig and drilled.

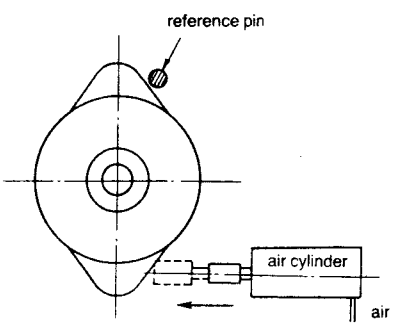
Before Improvement:

The drilling jig had a reference pin for positioning the workpiece, but the operator sometimes forgot to move the workpiece into contact with the pin. The operator went ahead with the drilling, assuming that the part was in the correct position. This resulted in holes drilled in the wrong position, making the item defective.



After Improvement:

An air cylinder was installed on the jig to press the workpiece against the reference pin after it is mounted.



● *Example 4*

Process: Countersinking **Prevent Error:** X **Shutdown:**

Problem: Countersinking was omitted **Detect Error:** **Control:** X

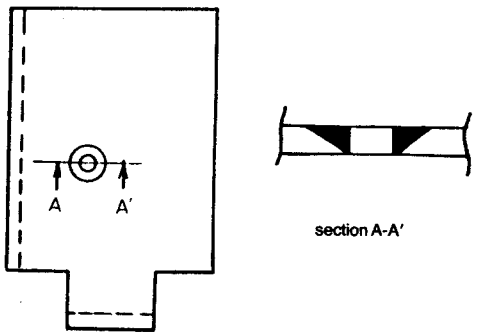
Solution: Modify hole punch to make and countersink hole in one operation **Alarm:**

Key Improvement: Tool modified to guarantee correct process

Description of Process: Countersinking is specified for holes punched in radiator plates.

Before Improvement:

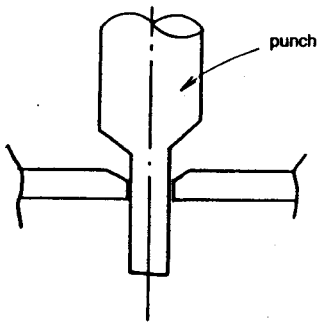
After punching, the holes were countersunk with a drill press, but there were variations in the dimensions and the processing was sometimes omitted.



shaded area removed by drill

After Improvement:

The punch was remodeled to punch and countersink the hole in one operation. Dimensional variations and omissions are completely eliminated and the processing time is shortened, killing two birds with one stone. The only costs are for remodeling the punch.



punch shape improved

• *Example 5*

Process: Riveting

Problem: Right angle of plate deformed

Solution: Improve jig

Prevent Error: X

Detect Error:

Shutdown:

Control: X

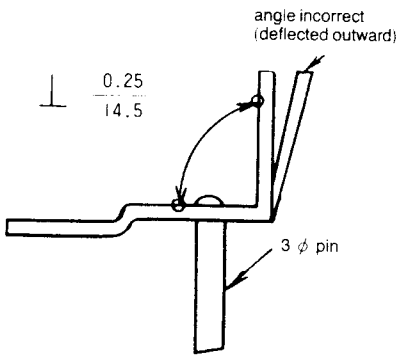
Alarm:

Key Improvement: Jig modified to guarantee correct positioning

Description of Process: Pins are riveted to a plate near an inside right angle corner.

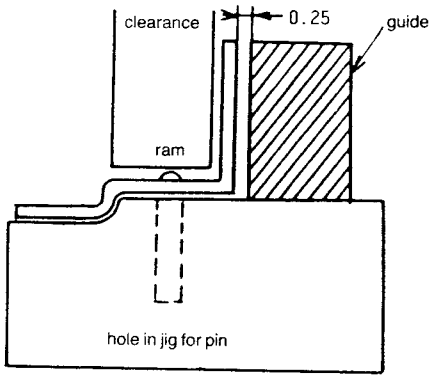
Before Improvement:

The riveting operation often bent the corner into an oblique angle.



After Improvement:

After reexamining how the defect occurred, a guide was installed on the jig to keep the plate at the proper angle during riveting.



• *Example 6*

Process: Mounting cassette transport covers

Problem: Plastic covers were scratched when screwdriver slipped out of screw slots

Solution: Change shape of screw slots

Prevent Error: X

Detect Error:

Shutdown:

Control: X

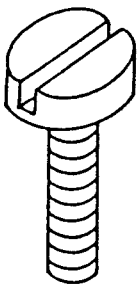
Alarm:

Key Improvement: Part modified to protect it from damage

Description of Process: Plastic cassette transport covers are assembled with screws.

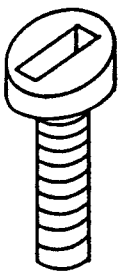
Before Improvement:

Cassette covers were frequently scratched when the screwdriver slipped out of the screw slot and slid against the plastic covers.



After Improvement:

The cause of the trouble was scrutinized and a change was made in the shape of the screw slot to prevent the screwdriver from slipping. Scratches caused by the screwdriver slipping have been completely eliminated.



• *Example 7*

Process: Press molding

Problem: Molded products left in press

Solution: Photoelectric detection of molded products in press

Key Improvement: Tool modified to protect it from damage

Prevent Error: X

Detect Error:

Shutdown: X

Control:

Alarm:

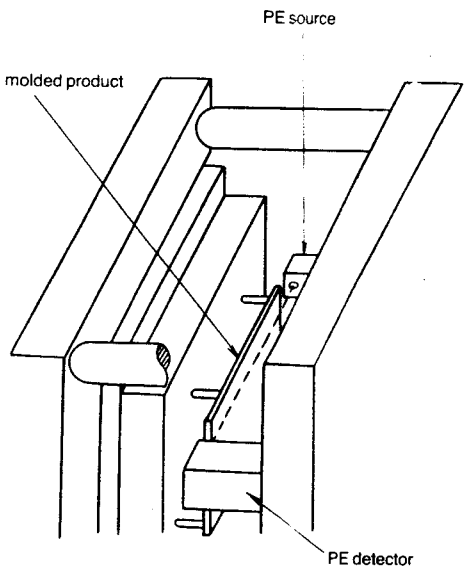
Description of Process: Products were molded on a press.

Before Improvement:

Sleepy night-shift operators sometimes forgot to remove molded products before operating the press again. Because correct operation relied on the workers' vigilance, die failures or defective products occurred about once a month.

After Improvement:

A photoelectric switch is used to detect the presence of molded products. If molded products remain in the press, the switch is disabled and the press cannot be operated. Smashing of molded products and die failures are completely eliminated.



● *Example 8*

Process: Staking a shaft to a plate

Problem: Shaft reversed end to end

Solution: Make ends of shaft interchangeable

Prevent Error: X

Detect Error:

Shutdown:

Control: X

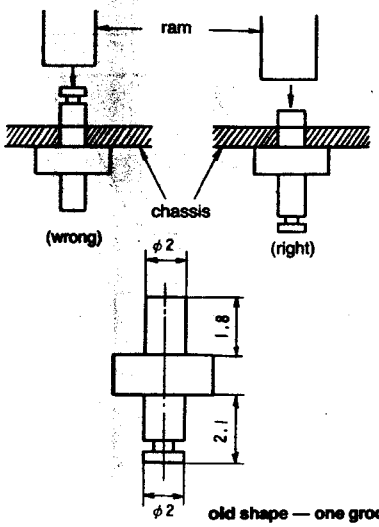
Alarm:

Key Improvement: Part modified to guarantee correct positioning

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

Before Improvement:

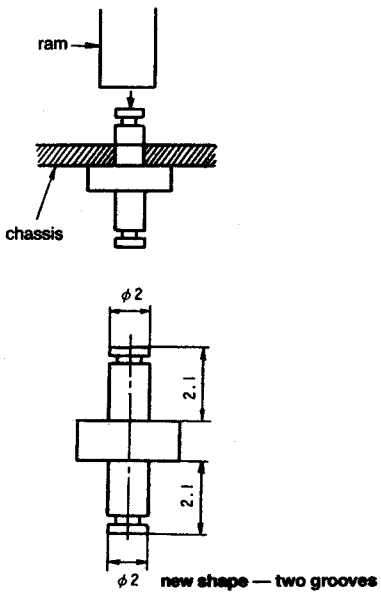
One end of the shaft was grooved for an E-ring, while the other end had no groove. Aside from that difference the shaft was symmetrical and the operator could join the shaft to the chassis with either end free. This resulted in errors that made it impossible to mount the E-ring during later assembly.



old shape — one groove

After Improvement:

Both ends of the shaft are now grooved for an E-ring, so either end can be staked to the chassis without creating an error. The E-ring can always be mounted and it is impossible to create a defect.



new shape — two grooves

• *Example 9*

Process: Joining a shaft to a control arm

Problem: Wrong end of shaft inserted

Solution: Change size of hole and shaft to prevent errors

Key Improvement: Part modified to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown:

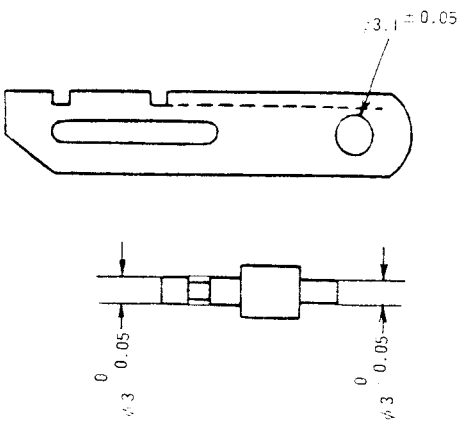
Control: X

Alarm:

Description of Process: A shaft is pressed into a press hole in a control arm.

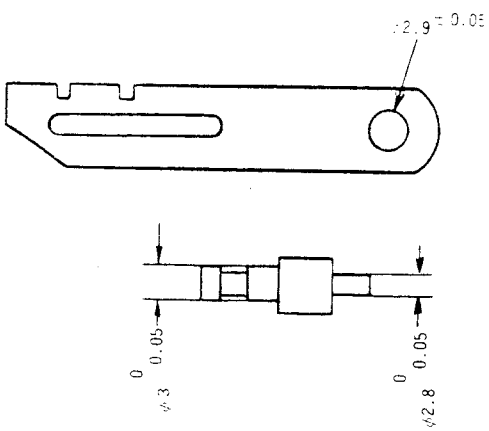
Before Improvement:

The two ends of the shaft had the same diameter, and either end could be pressed into the hole. Shafts were often pressed into the hole backwards.



After Improvement:

The diameters of the press hole and the end of the shaft to be pressed were made smaller so that the other end does not fit the press hole. The danger of backward press-fitting is completely eliminated.



• *Example 10*

Process: Staking

Prevent Error:

Shutdown:

Problem: Component joined to wrong side of plate or omitted altogether

Detect Error: X

Control: X

Solution: Install limit switch on subsequent process to detect proper staking

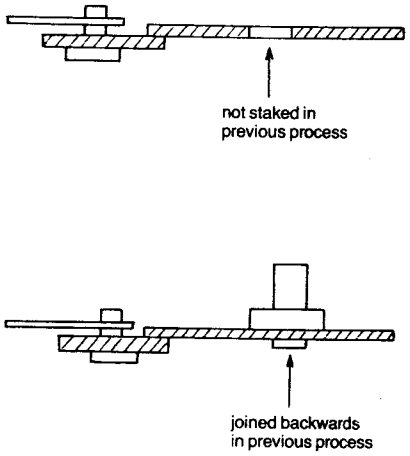
Alarm:

Key Improvement: Tool modified to detect defective parts

Description of Process: A shaft-like component is staked into a hole in a plate.

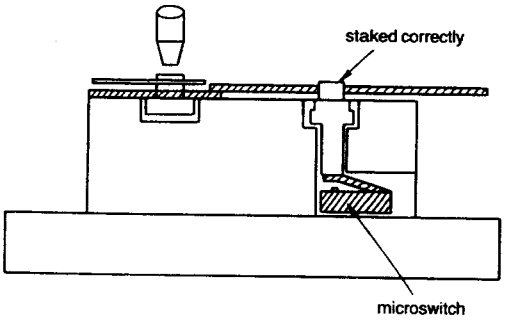
Before Improvement:

It was possible to stake the component to the wrong side of the plate or to omit it altogether.



After Improvement:

The subsequent process was equipped with a microswitch so the machine will not operate if the component is not staked or is joined to the wrong side in the previous process. Pieces with these defects are no longer passed on down the line.



• *Example 11*

Process: Processing chassis

Problem: Chassis set backwards in jig

Solution: Additional guide pin taking advantage of asymmetry

Key Improvement: Jig modified to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown:

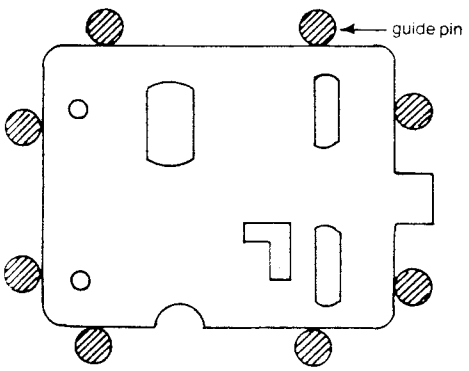
Control: X

Alarm:

Description of Process: A chassis was placed in a jig for machining.

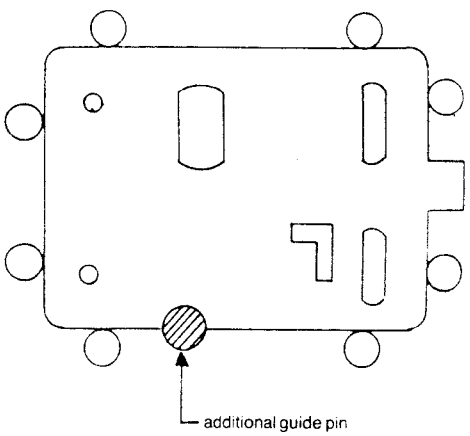
Before Improvement:

It was possible to insert the chassis in the jig backwards. Correct operation depended on the worker's vigilance.



After Improvement:

A guide pin was added, keyed to an asymmetrical feature of the chassis. This completely eliminates the danger of backward processing.



• *Example 12*

Process: Riveting coupling bars

Problem: One bar joined upside down

Solution: Add guide pin to riveting jig

Prevent Error: X

Detect Error:

Shutdown:

Control: X

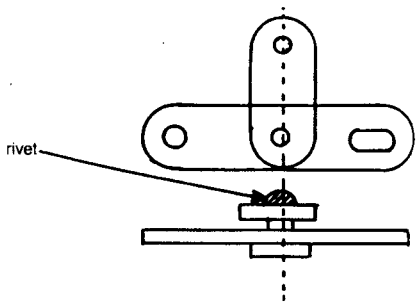
Alarm:

Key Improvement: Jig modified to guarantee correct positioning

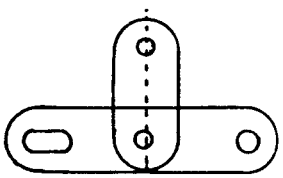
Description of Process: Two bars are riveted together.

Before Improvement:

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 and to join them that way, resulting in defects.



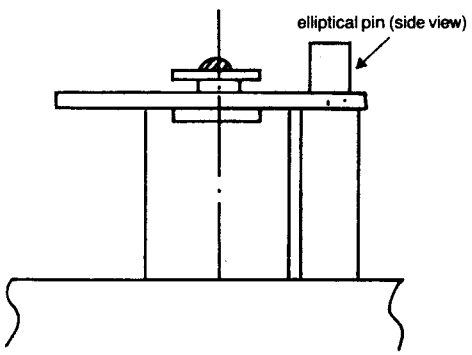
correct



incorrect

After Improvement:

An elliptical preventive pin was added to the jig so that the bar cannot be seated on the jig in the wrong direction. Backward riveting is completely eliminated.



• *Example 13*

Process: Punching holes in shield cases **Prevent Error:** X **Shutdown:**

Problem: Holes punched in wrong positions **Detect Error:** **Control:** X

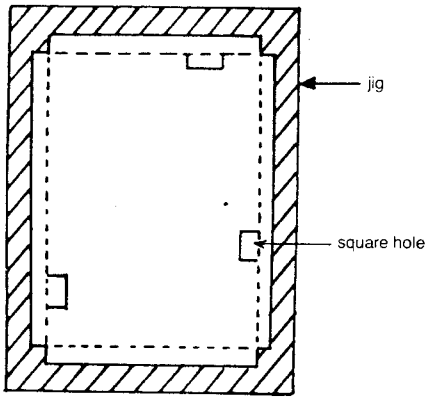
Solution: Make shield cases asymmetrical and add extra guide pin **Alarm:**

Key Improvement: Part and jig modified to guarantee correct positioning

Description of Process: Shield cases are set on a jig and square holes are punched out.

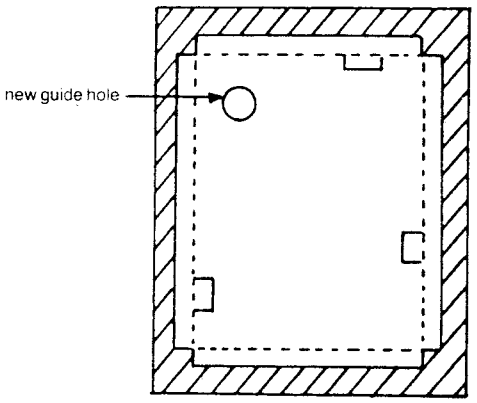
Before Improvement:

Since the cases were symmetrical, they could be set into the jig in reverse, and the square holes were often punched in the wrong positions.



After Improvement:

A round hole was designed into the case in an asymmetrical position, and a corresponding guide pin is mounted on the jig. The risk of punching square holes in the wrong places is completely eliminated.



• *Example 14*

Process: A series of processes involving silver-lined phosphor bronze sheet

Problem: Multiple positional errors

Solution: Visual indicators of correct setup

Prevent Error: X

Detect Error:

Shutdown:

Control: X

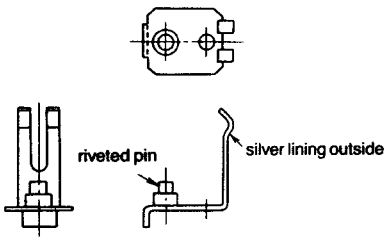
Alarm:

Key Improvement: Examples of correct processing provided as guides

Description of Process: Sheet stock of silver-lined phosphor bronze undergoes a series of operations to form the final product. The stock is first punched on a press, then press-bent (the usual practice is to perform these operations at the same time using sequential-feed or tandem-feed dies). The parts are then annealed and riveted to other parts.

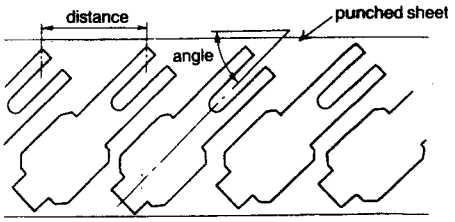
Before Improvement:

In each process errors occurred when the part was processed upside down or set incorrectly in the jig. The parts were pressed from the sheet upside down, or bent upside down, or the pins were riveted in the wrong hole or to the wrong side.



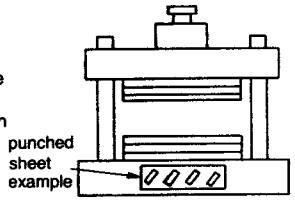
After Improvement:

Several different safeguards were installed to help the workers make visual checks that processing is proceeding correctly.

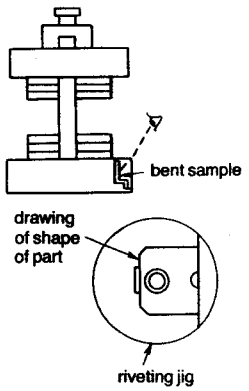


1. A sheet that has been punched out is attached to the front surface of the press as an example. By referring to this, the operator can tell both the processing distance and the correct angle. This prevents errors when positioning the sheet for punching the outer shape.

2. A correctly bent sample is also attached to the press. The operator can easily see the correct direction to bend the part. This prevents errors in bending direction.



3. A picture of the shape of the parts is drawn on the riveting jig so the operator can see which of the two holes the pin fits in and which side is the front. This prevents errors in riveting and connecting the part to other parts.



• *Example 15*

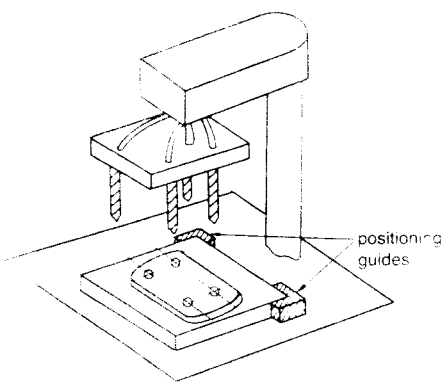
Process:	Drilling a variety of different workpieces	Prevent Error: X	Shutdown:
Problem:	Errors made during setup for different workpieces	Detect Error:	Control: X
Solution:	Eliminate setups		Alarm:

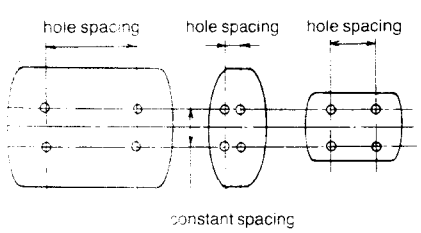
Key Improvement: Jig modified to guarantee correct positioning

Description of Process: Four mounting holes are drilled in many different types of plates. The holes are all equally spaced in one dimension, but are spaced differently along the other axis, depending on the size of the plate.

Before Improvement:

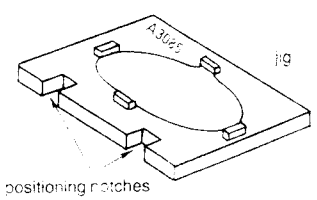
The holes were drilled with a four-spindle drill press, which required setup for each different type of plate. When the number of types of plates increased, time required for setup increased as well, and setup errors increased, resulting in incorrectly drilled holes.

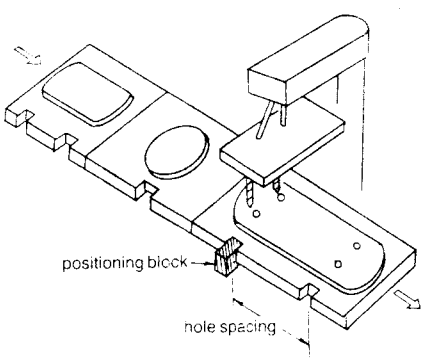




After Improvement:

A new method for drilling the mounting plates was developed that makes setup operations unnecessary and completely eliminates defects in hole spacing. A two-spindle drill press is set to the constant hole spacing used in all the plates. A stop block is located on the drill press table in line with the spindles, and the jigs for the different plates now have notches at each hole position. The block fits into the notch in the jig as each plate is fed in. It is now possible to continuously feed the workpieces and position them accurately.





• *Example 16*

Process: Laminating **Prevent Error:** X **Shutdown:**

Problem: Glue adhering to roller **Detect Error:** **Control:** X

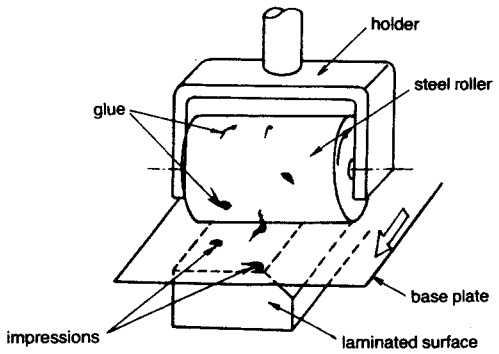
Solution: Moisten roller to prevent glue from sticking **Alarm:**

Key Improvement: Tool modified to protect it from damage

Description of Process: In a certain process, a metal roller is used to laminate two surfaces bonded with hot melted glue.

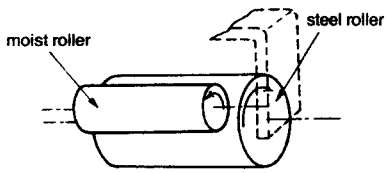
Before Improvement:

The glue tended to adhere to the steel roller. The adhering glue made impressions on the top surface of the laminate, resulting in defects. The machine was stopped every twenty to thirty minutes to remove the glue, but defective products continued to amount to as much as 50 percent of the total output.



After Improvement:

After an investigation into what conditions would prevent the glue from sticking to the steel roller, it was discovered that if the steel roller is dampened, the glue will not stick. A secondary roller is now used to dampen the steel roller during the lamination process, preventing the glue from adhering to the steel roller. As a result, defects caused by impressions are completely eliminated and productivity is improved almost fourfold.



• *Example 17*

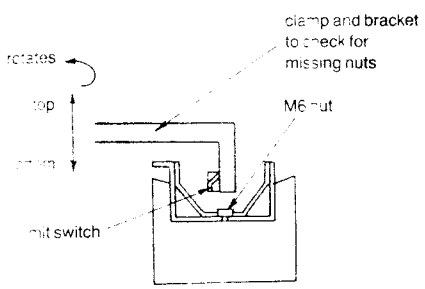
Process:	Mounting nuts	**Prevent Error:**	**Shutdown:** X
Problem:	Nuts missing or improperly positioned	**Detect Error:** X	**Control:**
Solution:	Limit switch detector		**Alarm:**

Key Improvement: Tool modified to detect defective parts

Description of Process: A dedicated machine is used for mounting nuts onto parts for numerous different models.

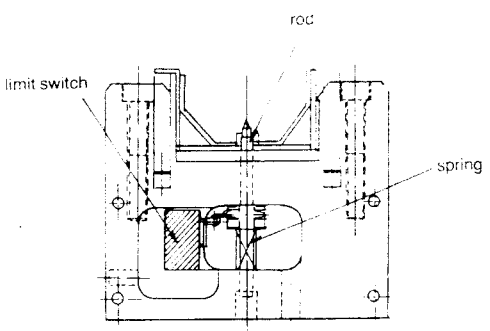
Before Improvement:

Omission of nuts or faulty centering of nuts occurred and caused trouble during later assembly. A clamp was used to check for missing nuts, but faulty nut centering could not be detected.



After Improvement:

The machine power was connected to a limit switch that is actuated by a spring-mounted rod. If the nut is missing, the rod goes through the hole and the limit switch remains off. On the other hand, if the nut is off-center, the rod cannot rise at all, and the limit switch also stays off. If the nut is positioned correctly, the rod rises enough to turn on the limit switch, but no further. Selection switches are used to change the settings for different models.



• *Example 18*

Process: Roll-forming threads

Problem: Operation omitted or defective

Solution: Limit switch to detect omitted operation; use of more appropriate section of part for reference

Key Improvement: Jig modified to guarantee correct positioning; tool modified to detect defective parts

Prevent Error: X

Detect Error: X

Shutdown: X

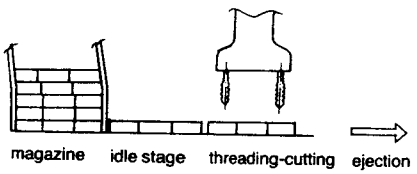
Control: X

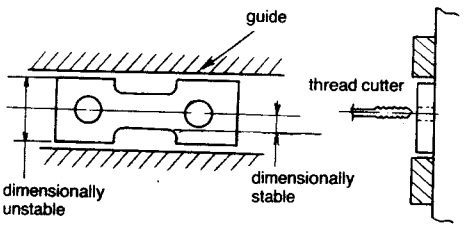
Alarm:

Description of Process: A two-spindle roll-forming machine is used to cut threads in a certain part.

Before Improvement:

Products with defective threads were produced because the guide had enough clearance that the workpiece could shift during forming. In addition, when the machine was started up after an emergency shutdown or a power loss, unthreaded parts were ejected at first. Items with faulty threads and items with no threads cut were sorted out by the workers, but some defects got by.

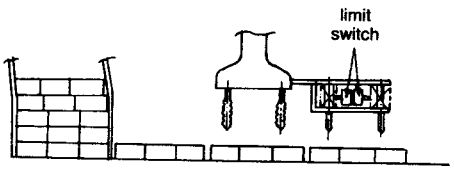




After Improvement:

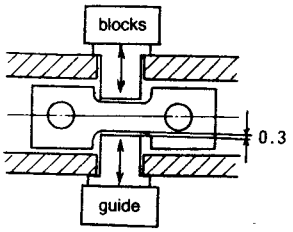
Correctly threaded items, unthreaded items, and items with faulty taps all have different hole diameters. A device that checks the inner diameter of the holes and a limit switch circuit to shut off the threading operation are used together to eliminate defects and prevent the occurrence of defective items at the beginning of work.

1. Hole diameter before threading ϕ 7.3
   Hole diameter if threading is faulty ϕ 7.5
   Hole diameter if threading is good ϕ 6.8
   Check pin diameter ϕ 7.0



2. A limit switch circuit is added to detect omitted or faulty threading.

3. The guide is revised, adding blocks to hold the workpiece in a stable position for threading.



• *Example 19*

Process: Tapping with multispindle tapping machine

Problem: Defective or omitted tapping

Solution: Limit switches detect correct tapping

Key Improvement: Tool modified to guarantee correct processing

Prevent Error:

Detect Error: X

Shutdown: X

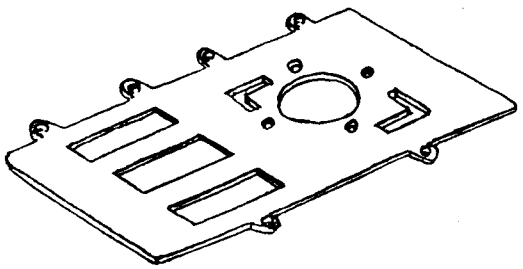
Control:

Alarm:

Description of Process: Ten holes are tapped simultaneously on a multispindle tapping machine. If a tap breaks, or becomes worn, tapping will be defective or omitted.

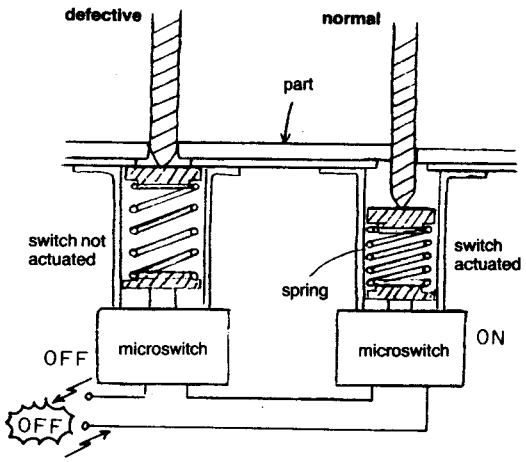
Before Improvement:

The workers' vigilance was relied on to detect errors. Operators often failed to notice problems and workpieces sometimes passed onto the next process with defects. Every time this happened, the line shut down at a later process.



After Improvement:

Microswitches were installed under each tap drill, and the machine shuts down if any of the ten drills fails to actuate its switch.



• *Example 20*

Process: Drilling

Problem: Missing holes

Solution: Hole detector before next process

Key Improvement: Tool modified to detect defective parts

Prevent Error:

Detect Error: X

Shutdown: X

Control:

Alarm:

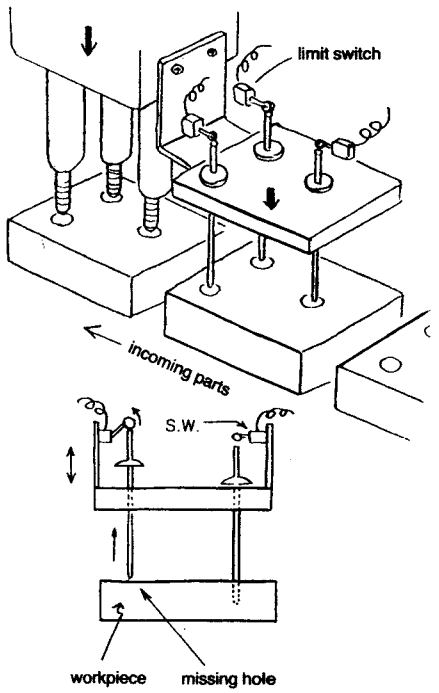
Description of Process: Several holes are drilled in a plate in the preceding process. The holes are then finished using a multispindle drill press.

Before Improvement:

When an unprocessed item produced by the drilling machine in a preceding process came to the hole-finishing process, the finishing drills often broke. If this went unnoticed, all of the workpieces that came along the line afterward would have unfinished holes. It was extremely troublesome to process these defective workpieces afterward.

After Improvement:

A set of hole-detecting pins was mounted on the hole-finishing machine to detect the presence of holes in the next part while the current part is being processed. The pins are connected to limit switches that shut down the finishing machine if holes are not detected in the next part.



• *Example 21*

Process: Bending stamped parts

Problem: Parts bent upside down

Solution: Use cloth-lined chute to stop upside-down parts

Key Improvement: Chute modified to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown:

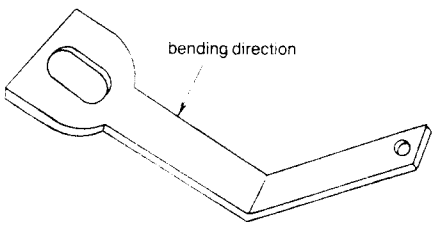
Control: X

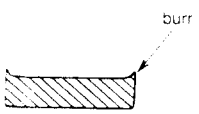
Alarm:

Description of Process: In this process, punched parts are bent to shape, with the burr resulting from punching on the inside of the bend.

Before Improvement:

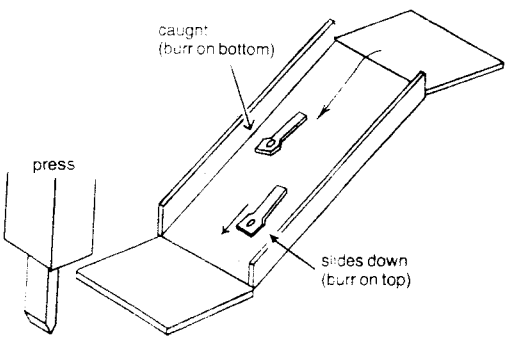
The worker checked the orientation of the parts before bending each time but inevitably made errors.

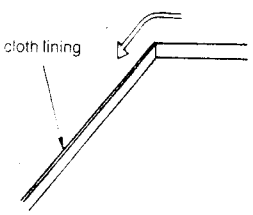




After Improvement:

After punching, the parts are slid down a chute lined with cloth. If the burrs are on the bottom of the piece (improper position for bending), they catch on the cloth and do not slide to the bottom of the chute. The parts that reach the bottom have the burr side up and can be pressed immediately.





• *Example 22*

Process: Processing wire stock **Prevent Error:** X **Shutdown:** X

Problem: Deposits of foreign matter on stock and variations in wire dimensions **Detect Error:** **Control:**

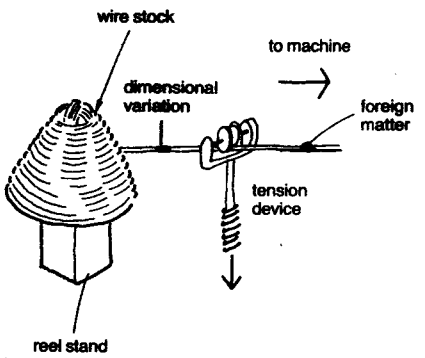
Solution: Stopper on wire feeder halts process if wire is out of dimension **Alarm:**

Key Improvement: Tool modified to protect it from damage

Description of Process: Wire stock is sometimes produced with shape or dimensional variations or with foreign matter stuck to the stock. When this defective stock is processed, these variations must be detected to prevent defective products.

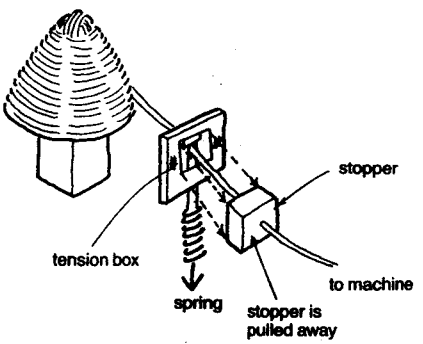
Before Improvement:

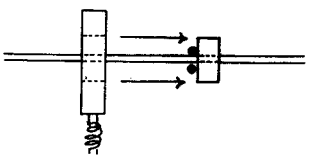
Deposits of foreign matter or variations of the wire stock dimensions made the motor stall when the wire stock entered the processing machine.



After Improvement:

If there is any foreign matter or a shape or dimensional variation on the wire, a stopper on the feed device catches on the wire at that place and moves along with the wire. The machine stops automatically when the stopper strikes a limit switch inside the machine.





• *Example 23*

Process: Milling molded items | **Prevent Error:** | **Shutdown:**

Problem: Unprocessed items | **Detect Error:** X | **Control:** X

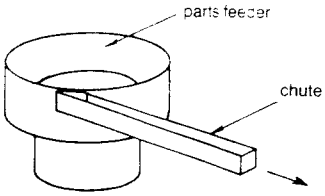
Solution: Use dimensional differences to detect unprocessed items in delivery chute | **Alarm:**

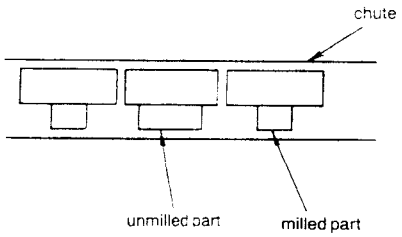
Key Improvement: Chute modified to detect defective parts

Description of Process: Molded items are milled in an automatic machine and delivered to the next process via a chute.

Before Improvement:

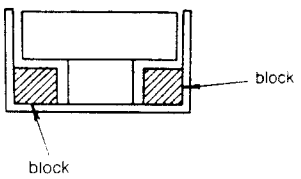
If an unmilled part came through the chute, the next machine shut down abnormally and could be damaged.

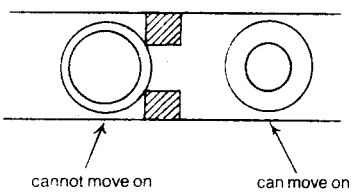




After Improvement:

A method was devised to use the geometrical shape of the unmilled parts to stop them if they come along. The feed chute is modified so that an unmilled part is caught by a block installed in the chute and is not delivered to the next machine. Damage to the machinery is prevented.





• *Example 24*

Process: Press-fitting capacitors | **Prevent Error:** X | **Shutdown:** X

Problem: Capacitor improperly positioned | **Detect Error:** | **Control:**

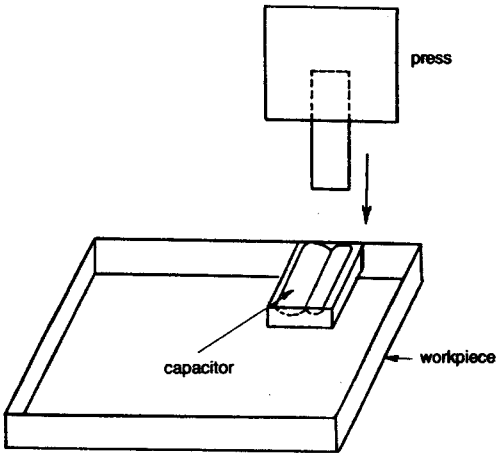
Solution: Jig with limit switch | **Alarm:**

Key Improvement: Jig used to guarantee correct positioning

Description of Process: Capacitors are press-fitted to a workpiece.

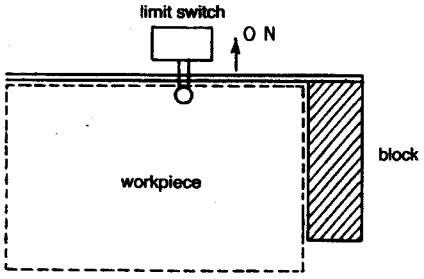
Before Improvement:

The worker determined the press-fitting position visually and the workpiece was often positioned inaccurately. Defects such as bending or damage occurred.



After Improvement:

A jig was made to position the workpiece and capacitor. The wiring is also changed so that the press cannot be activated until the limit switch is actuated by proper positioning. This eliminates the processing errors.



• *Example 25*

Process: Press-fitting bellows seals to O-rings

Problem: Faulty alignment

Solution: Jig to ensure correct alignment

Key Improvement: Jig to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown: X

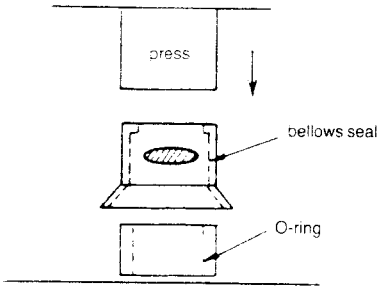
Control:

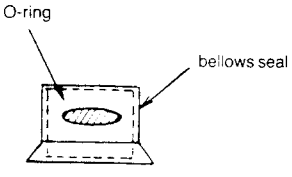
Alarm:

Description of Process: Bellows seals are press-fitted to O-rings.

Before Improvement:

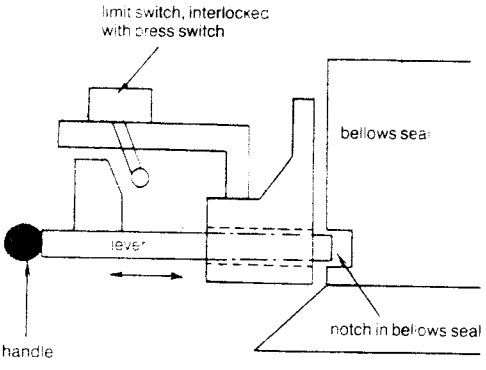
The alignment between the bellows seals and the O-rings was determined visually. Variations of the press-fitting depth and deformations of the bellows seals often occurred as a result.





After Improvement:

A guide was installed so the bellows seals are always press-fitted uniformly. The press cannot be actuated unless a lever protruding from the guide has been inserted into the oblong notch in the bellows seal. This makes it possible to perform the press-fitting accurately.



• *Example 26*

Process: Various **Prevent Error:** X **Shutdown:**

Problem: Worn pattern templates **Detect Error:** **Control:** X

Solution: Mark templates to make visual inspection easy **Alarm:**

Key Improvement: Gage used for inspection

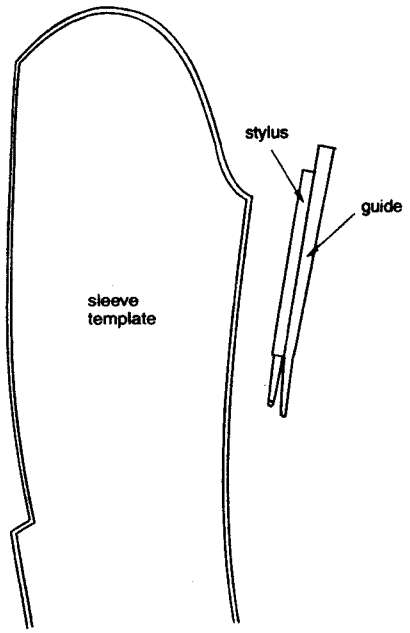
Description of Process: Sheet metal pattern templates for cutting garment pieces sometimes become damaged during use. It is important to maintain accurate templates so the garments will fit properly when assembled.

Before Improvement:

It was difficult to determine whether the template was worn and needed repairing, and inaccurate garment pieces were cut as a result.

After Improvement:

Using a guide, a stylus is used to scribe a line 1 mm in from the edge of the template when the template is new. After the template is used, the worker visually inspects this margin. Any variations, especially nicks and dents, are easy to detect. If there is any damage (if the interval is less than 1 mm), the template is repaired. This method is fast and easy because it uses visual inspection and is simple to understand.



• *Example 27*

Process: Sewing buttons onto suit jacket cuffs

Problem: Buttons unevenly spaced

Solution: Jig

Key Improvement: Jig used to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown:

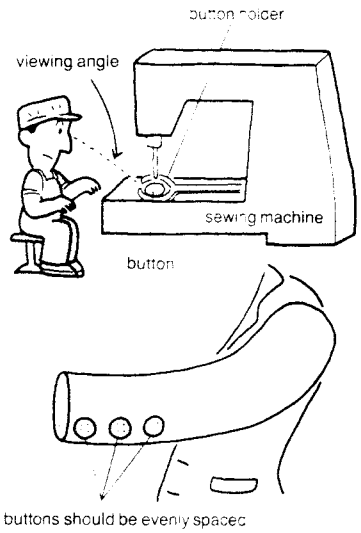
Control: X

Alarm:

Description of Process: Some jacket cuffs have two buttons, others have three, and still others have four, depending on the design. The buttons are sewn on the cuffs one at a time using a large sewing machine.

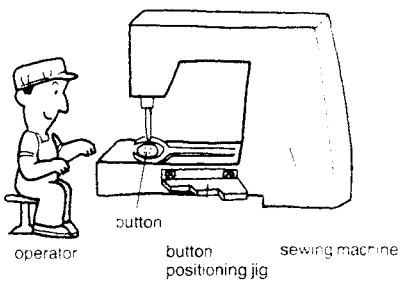
Before Improvement:

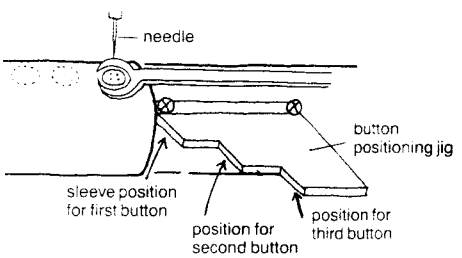
The operator made marks at each button position and then sewed the buttons on, following the marks. However, partly because of problems with the sewing machine mechanism, and also due to the viewing angle, buttons were not sewn exactly at the right positions, resulting in uneven space between the buttons.



After Improvement:

A positioning jig was developed for sewing buttons. Now cuffs are positioned for buttons merely by putting the cuff end against the jig mounted on the sewing machine. This positions the cuff accurately for the required number of buttons and they come out neatly in a row.





• *Example 28*

Process: Camera lens assembly **Prevent Error:** X **Shutdown:**

Problem: Crimping omitted **Detect Error:** **Control:**

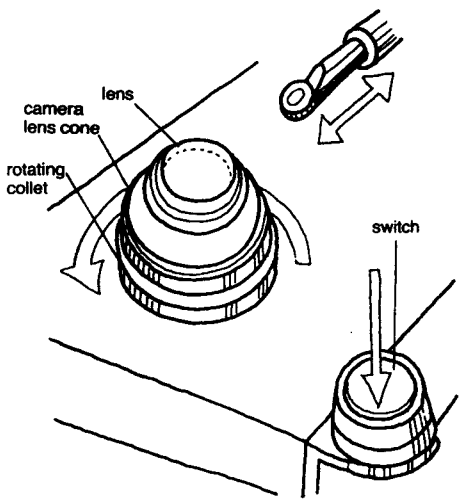
Solution: Photoelectric switch interlocked with crimping machine switch **Alarm:** X

Key Improvement: Tool modified to guarantee correct processing

Description of Process: The glass camera lens is assembled to the camera lens cone using a crimping machine.

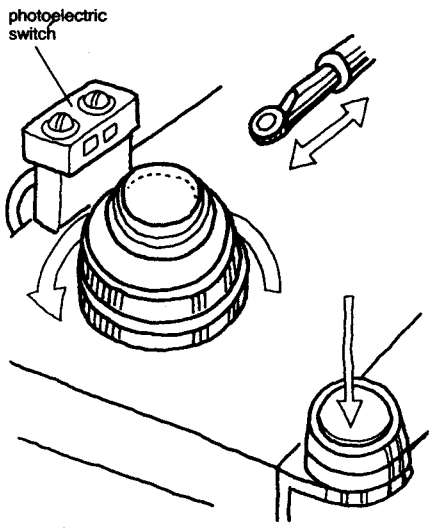
Before Improvement:

After the operators set the lens in the lens cone and set the assembly in position on the crimping machine, they sometimes forgot to press the switch to start the process. As a result, the lens sometimes went on to the next process without being sealed into the lens cone.



After Improvement:

A reflecting-type photoelectric switch was mounted on the crimping machine, interlocked with the ON switch. The photoelectric switch is actuated when the metal lens cone is set in position in the jig of the crimping machine, and is released when the ON switch is pressed. If the operator forgets to press the switch, a buzzer sounds.



• *Example 29*

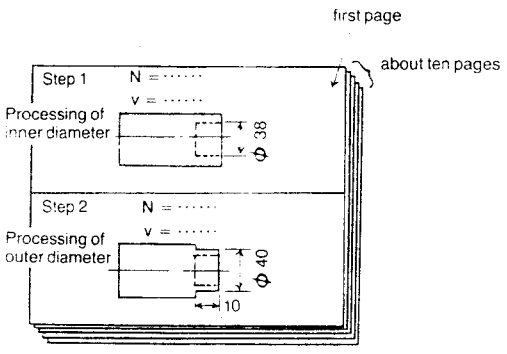
Process:	Various	**Prevent Error:**	X	**Shutdown:**	
Problem:	Following instructions for wrong process	**Detect Error:**		**Control:**	X
Solution:	Reorganize instruction charts			**Alarm:**	

Key Improvement: Tool modified to guarantee correct processing

Description of Process: Ten operations are covered by a group of instruction charts. The operator performs processing while consulting the dimensions listed for each operation.

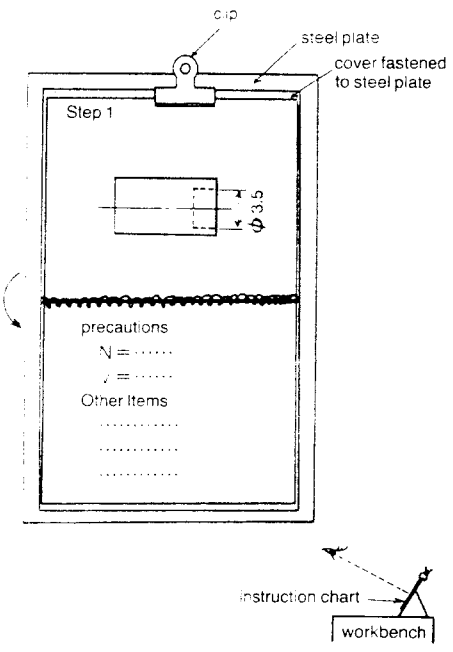
Before Improvement:

The operator was able to read instructions for the other operations while performing a given operation, since the instruction charts just sat on the workbench. Mistakes sometimes occurred because the operator accidentally followed the instructions for a different operation, such as using the dimensions for Step 2 while performing Step 1.



After Improvement:

The instruction charts were bound into a single file so the operator can see only the instructions for the operation being performed. The cover of the file is attached to a plate so the file can be propped open at an angle on the bench. To go on to the next process, the operator turns the page in the direction indicated by the arrow. Defects were completely eliminated.



• *Example 30*

Process: Rinsing lenses

Problem: Scratched lenses

Solution: Change position of lenses in lens holder

Key Improvement: Procedure modified to protect part from damage

Prevent Error: X

Detect Error:

Shutdown:

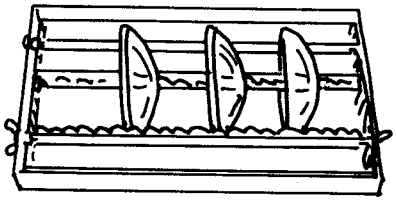
Control: X

Alarm:

Description of Process: Lenses are inserted into a rinsing rack and passed through a rinsing machine.

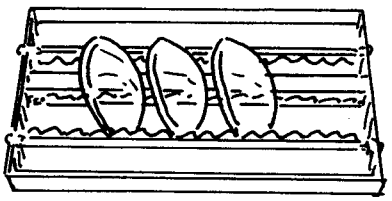
Before Improvement:

The lenses were inserted vertically into the plastic rinsing rack. Inspection of some sharply curved lenses after rinsing sometimes showed that they had scratches around their circumferences. Scratching was caused by the plastic rack blades striking the lenses because of vibrations during rinsing.



After Improvement:

It was discovered that the scratching does not occur when the lenses are inclined at an angle when inserted in the rinsing rack, which eliminates the movement of the lenses due to vibrations.



• *Example 50*

Process: Automatic parts feeder | **Prevent Error:** X | **Shutdown:**

Problem: Parts flipping upside down | **Detect Error:** | **Control:** X

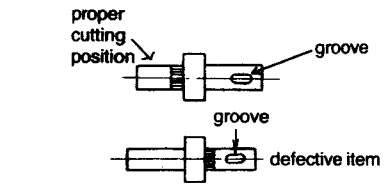
Solution: Improve automatic shutters | **Alarm:**

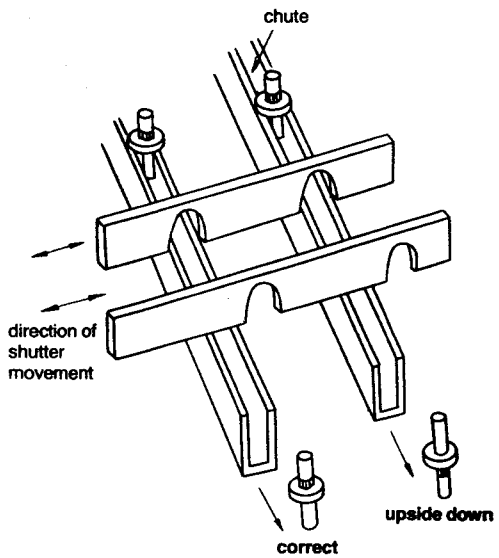
Key Improvement: Chute modified to guarantee correct positioning

Description of Process: Parts are fed individually by an automatic feeder to a process for cutting grooves on shafts.

Before Improvement:

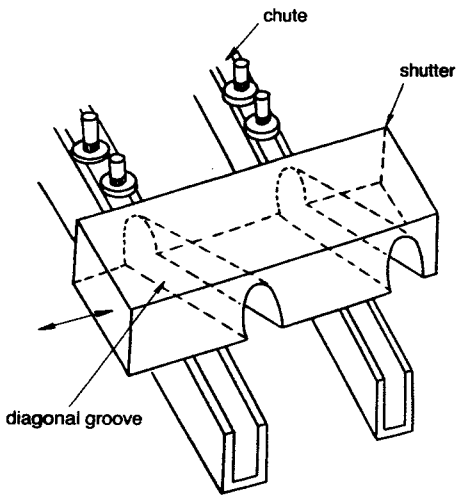
The shutters for individual feed on the shaft chutes were poorly designed and shafts in the chutes sometimes flipped upside down due to impact with the shutter. The grooves were then cut in the wrong end of the part, and no grooves were cut where they were needed.





After Improvement:

The shutters were redesigned to move the shafts gently down the chute, preventing them from flipping due to impact.



• *Example 51*

Process: Machining

Problem: Hand-held parts nicked during machining or machined while not centered

Solution: Jig to eliminate hand-held machining

Prevent Error: X

Detect Error:

Shutdown:

Control: X

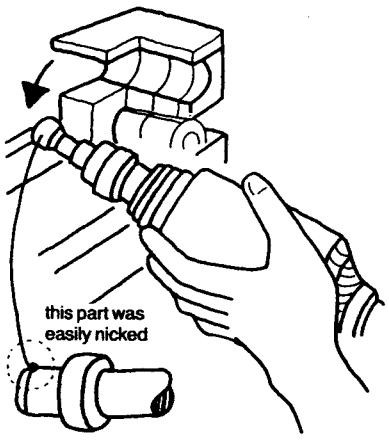
Alarm:

Key Improvement: Jig used to guarantee correct processing

Description of Process: Shafts are finished on a machine.

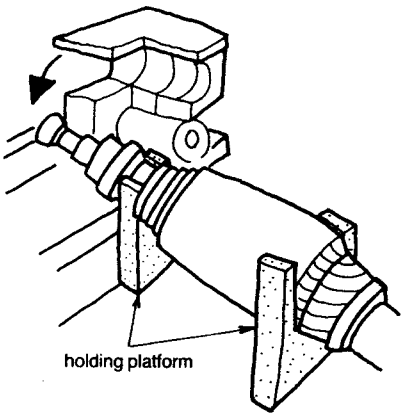
Before Improvement:

Workers held the shafts in their bare hands to process them. This required skill and time because the workpieces were unstable and difficult to center. In addition, the hand-held shafts were likely to be hit and nicked.



After Improvement:

Holding platforms were devised for resting the workpieces. The jig and the shafts can be centered quickly and accurately, avoiding damage to the parts.



platform positions shaft securely for machining

• *Example 52*

Process: Oxyacetylene cutting of large spherical sheets

Problem: Badly cut edges

Solution: Automate positioning of sheets being cut

Prevent Error: X

Detect Error:

Shutdown:

Control: X

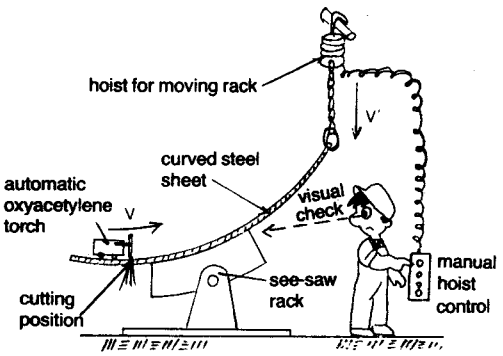
Alarm:

Key Improvement: Jig modified to guarantee correct positioning

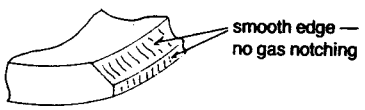
Description of Process: Large curved sheets of steel are cut with an automatic oxyacetylene torch in preparation for building tanks. The sheets are set into see-saw racks that move as the cutting is performed so the cutting torch remains horizontal.

Before Improvement:

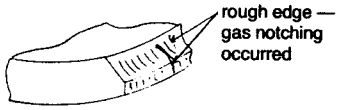
The worker operated the hoist for the see-saw rack manually in time with the movement of the cutting torch so the torch was continuously horizontal. However, one operator was in charge of a number of units, and if he was careless or got behind, the racks were moved late or not at all, resulting in faulty cutting and bad edges.



correctly cut

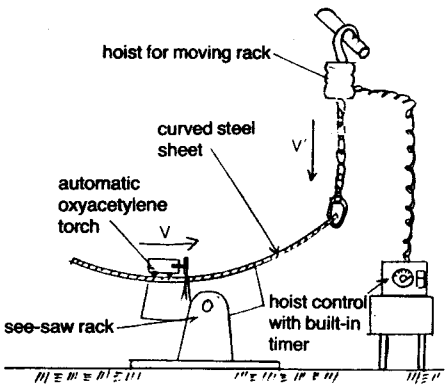


defective



After Improvement:

A timer was incorporated in the rack hoist to synchronize the speed of the automatic cutting torch with the speed of the hoist, so the cutter is always horizontal. This makes it possible to feed the cutter automatically and ensures good cutting results.



• *Example 53*

Process: Cutting raw material, with gravity feed device **Prevent Error:** X **Shutdown:** X

Problem: Positioning problems **Detect Error:** **Control:**

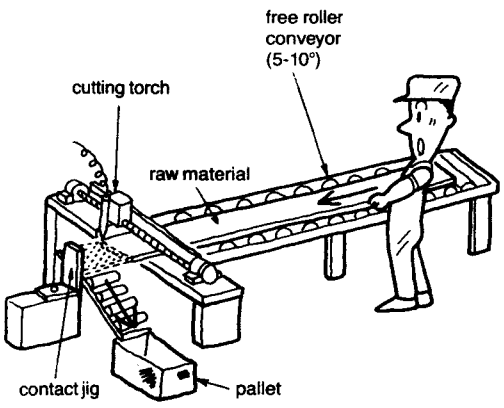
Solution: Install limit switch to detect proper positioning **Alarm:** X

Key Improvement: Operation prevented if part is not positioned correctly

Description of Process: A simplified automatic cutting machine is used to cut workpieces from raw materials. The raw material is fed by gravity, strikes a contact jig, and is cut by a gas cutting torch.

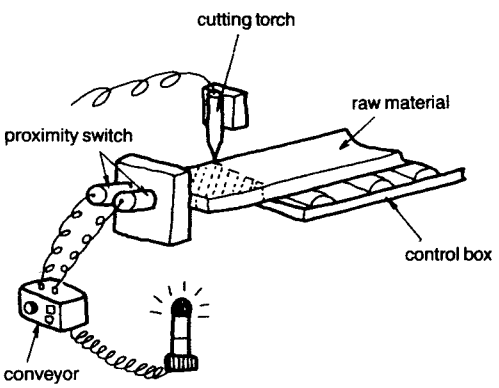
Before Improvement:

As more and more of the raw material was cut off, the supply became lighter and lighter until it became too light to position itself against the contact accurately. Defects occurred as a result.



After Improvement:

A proximity switch mounted inside the contact jig controls the device so the cutter will operate only after the switch indicates the workpiece is accurately set in place against the contact. A flashing light notifies the operator if the workpiece is improperly positioned.



• *Example 54*

Process: Transporting tall, narrow pins on a conveyor belt

Problem: Pins tipped at junctions in the conveyor belt

Solution: Change positions of stabilizing devices

Key Improvement: Transport modified to guarantee correct positioning

Prevent Error: X

Detect Error:

Shutdown:

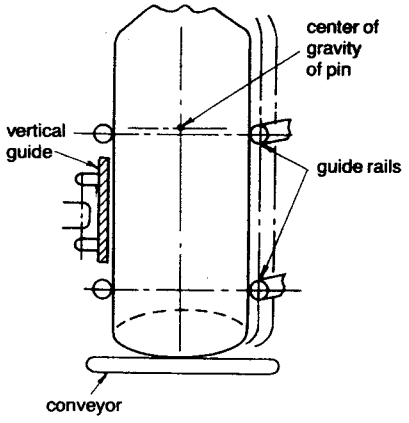
Control: X

Alarm:

Description of Process: Tall, narrow pins are transported on a conveyor belt.

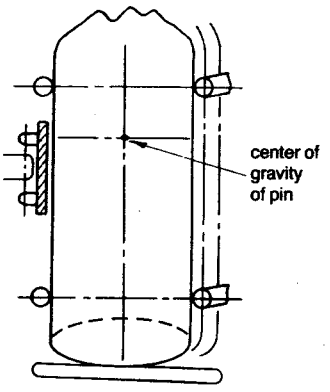
Before Improvement:

After the diameter of the pins was reduced 10 percent and the speed of the conveyor was increased by 30 to 40 percent, the rate of pins tipping at junction points rose suddenly.



After Improvement:

After considering the dynamics carefully, starting from the static state, it was determined that the geometry of the stabilizing devices must be improved. The guide for keeping the pin vertical as it moves around curves was raised nearer the center of gravity of the pin, and the upper guide rail was raised above the center of gravity. These modifications improve the traveling stability of the pins and completely eliminate defects.



• *Example 55*

Process: Inspecting cassette tape decks

Problem: Inspection tapes out of sequence

Solution: Use "first-in, first-out" tape rack

Prevent Error: X

Detect Error:

Shutdown:

Control: X

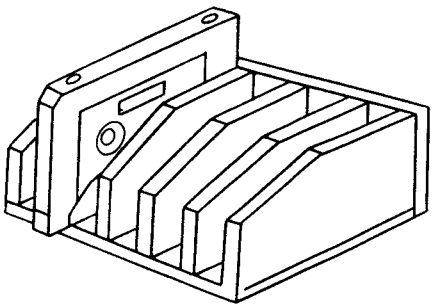
Alarm:

Key Improvement: Tool modified to guarantee correct processing

Description of Process: When a cassette deck is inspected, the inspector uses a series of cassette tapes to check the performance of the unit. It is important that the inspector perform the tests in the proper sequence and that all the tests are performed.

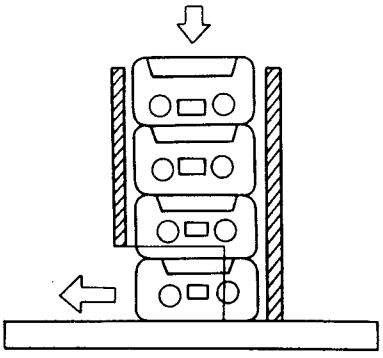
Before Improvement:

A slotted rack was used to store the tapes. If a tape was accidentally placed on the worktable or carried off, the inspector could lose track of how far inspection had gone. Errors might occur because the inspector thought that inspections had been performed that had not.



After Improvement:

A new "first-in, first-out" rack was developed that dispenses the tapes only in the proper order for testing. When one tape is removed for use, the next tape slides down, ready for use. When a tape has been used, the inspector places it in the top of the rack, where it remains in the correct order. Errors in the testing sequence are completely eliminated.



• *Example 56*

Process: Countersinking **Prevent Error:** X **Shutdown:**

Problem: Parts countersunk on wrong side **Detect Error:** **Control:** X

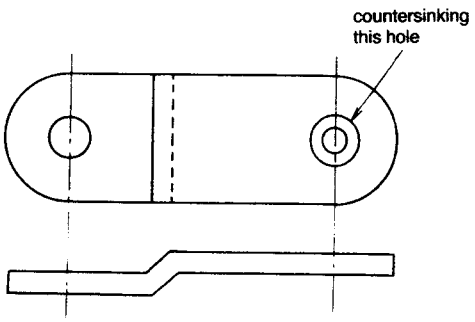
Solution: Prevent errors with new jig **Alarm:**

Key Improvement: Jig modified to guarantee correct positioning

Description of Process: A screw hole on a small part is countersunk.

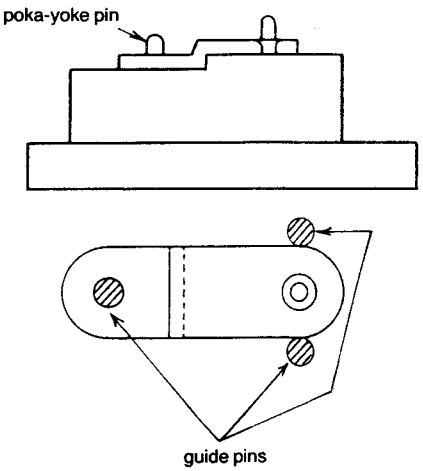
Before Improvement:

It was possible to set the part on the drill press table upside down and countersink the wrong side.



After Improvement:

A new jig was designed with a poka-yoke pin that prevents the part from being set up upside down. Reverse countersinking is completely eliminated.



Assembly Errors

• *Example 57*

Process: Tightening nuts **Prevent Error:** X **Shutdown:**

Problem: Missing washers **Detect Error:** **Control:** X

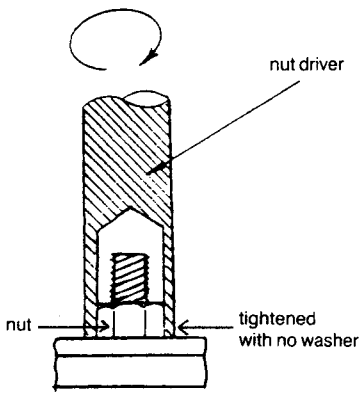
Solution: Modify nut driver so nuts can't be tightened if washer is missing **Alarm:**

Key Improvement: Tool modified to guarantee correct processing

Description of Process: Nuts were tightened using an automatic nut driver.

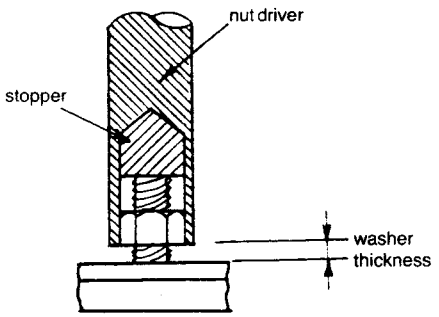
Before Improvement:

It was possible to tighten the nuts even if their washers were missing, and checking for the washers relied on worker vigilance. Defects occurred when nuts were tightened with their washers missing.



After Improvement:

A stopper was built into the nut driver. If the washer is missing, the bolt strikes the stopper and prevents the driver from tightening the nut. Missing washers are completely eliminated. Note: For this poka-yoke to work, variations in length of the bolt must be very carefully controlled.



• *Example 58*

Process: Changing setup of molding dies with separate bridges

Problem: Faulty bridge placement

Solution: Change shape of die body

Prevent Error: X

Detect Error:

Shutdown:

Control: X

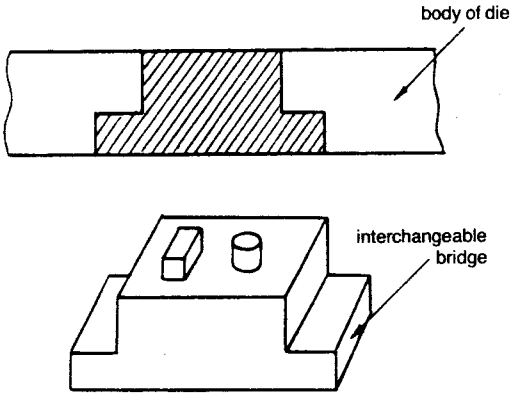
Alarm:

Key Improvement: Tool modified to guarantee correct processing

Description of Process: In molding operations, bridges are replaced to alter the die shape for different models.

Before Improvement:

Because the bridges were symmetrical right to left, they were sometimes mounted in reverse by inexperienced operators, leading to defects.



After Improvement:

The shape of the bridge was altered to prevent reverse mounting. Defects due to faulty placement of bridges are completely eliminated.