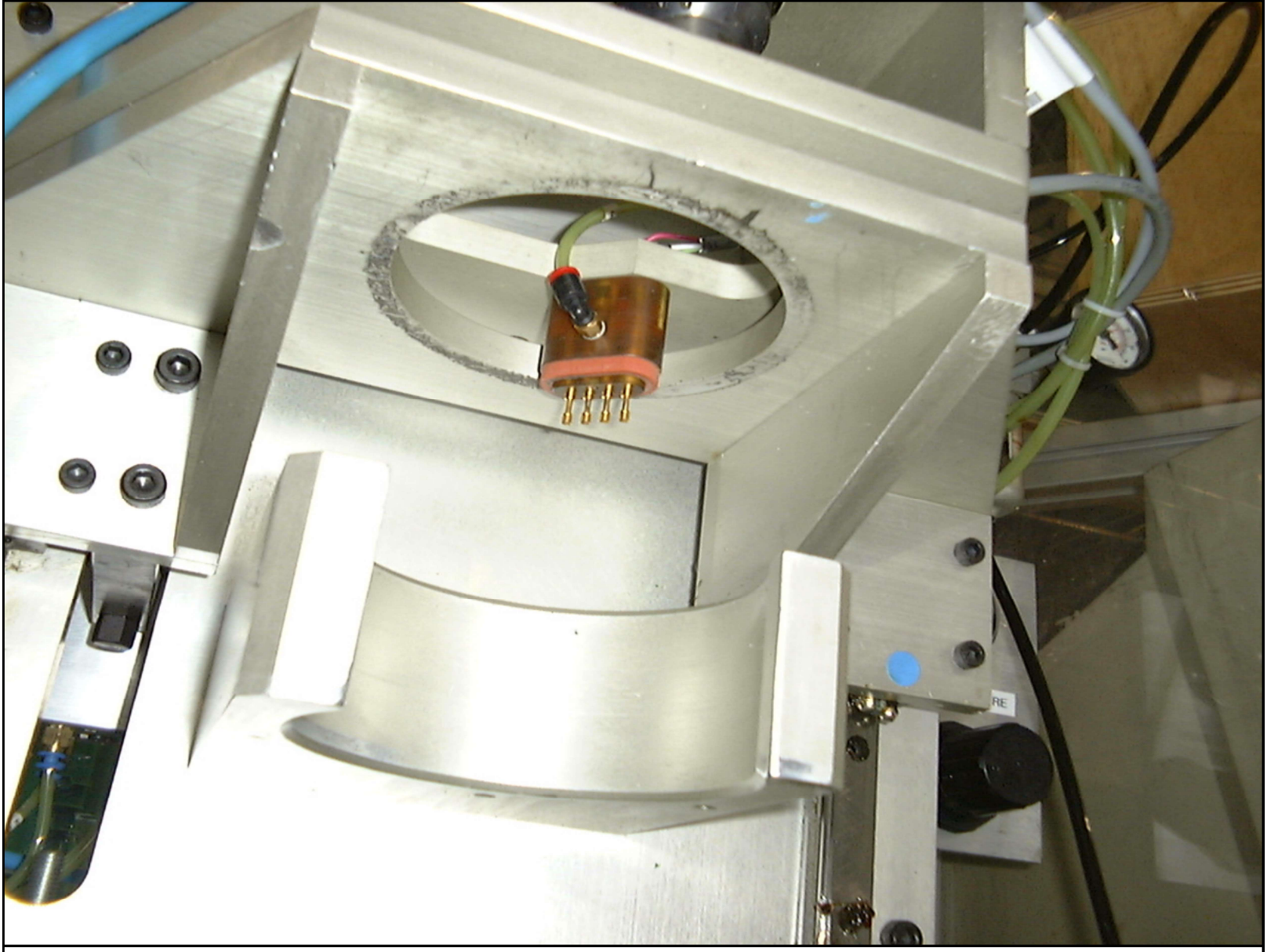
This picture shows a simple machine that was used to install an electrical circuit harness plug into the receptacle of gas tank level sender unit flange at a former employer.

This was of a very inferior design, poorly constructed and simply didn't work. The operators typically installed the harness plug into the receptacle by their hands and that was very hard on their hands and fingers. I later learned that $5,000.00 was paid to a local engineering company to design, build and install this unreliable machine.

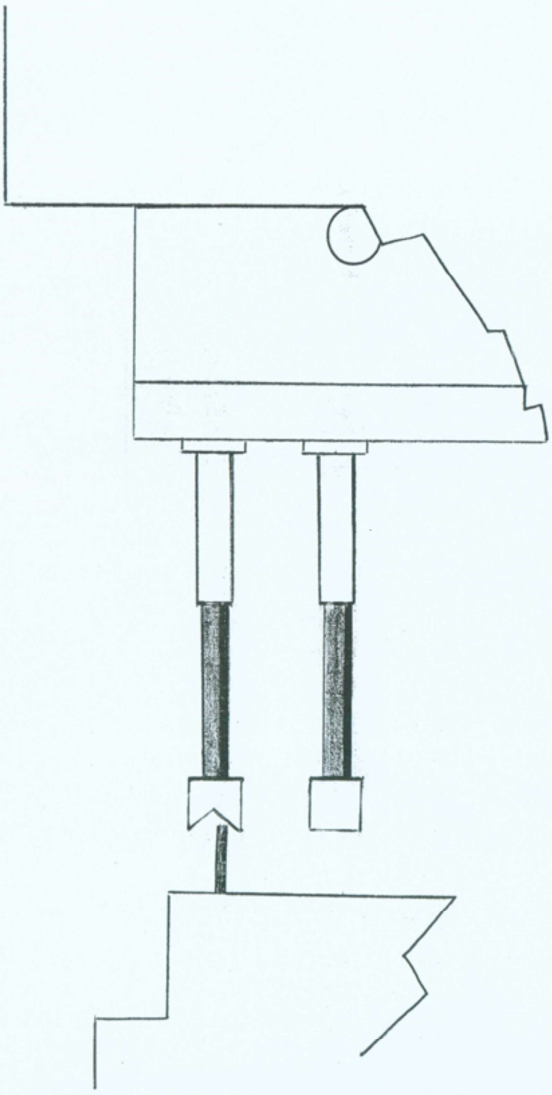
Fed up with having to constantly repair the original machine and not happy with the operators having to install the receptacle by their hands, I took matters into my own hands and designed, built and installed my own machine to do the job.

This was a major improvement in weakness in design, it was reliable, easier to operate and lasted with virtually no maintenance required to the end of the program of the manufactured part. Materials cost was under $1,000.00



Picture showing an electrical spring loaded contact test probes assembly. The service life of these test probes should have been in the high 10 million cycle range, but were lasting only a fraction of that life time cycle.

Because the test probes were gold plated they were expensive $20.00 each X 4 $80.00 and had to be changed out on average 4 times a month. Do the math…

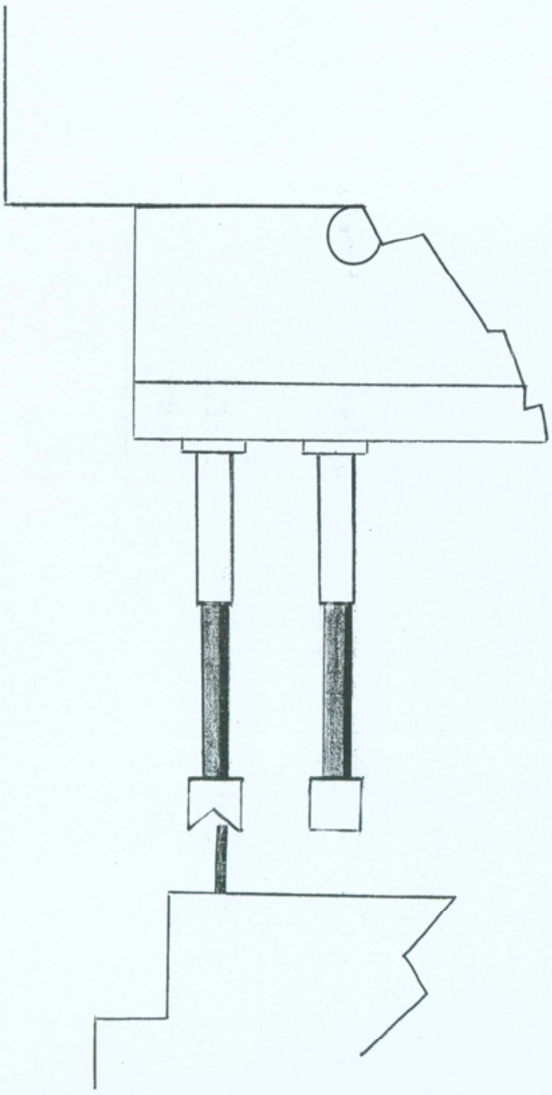


Changing out the test probes was easy and only took seconds to replace, but the cost was prohibitive considering that they should last much longer.

Using the P-M Analysis approach I set about to investigate this chronic problem. The original test probes were of a concaved head - see left sectioned test probe in illustration. During testing the part to be tested would be inserted into the test machine tool nest and the test probes would come into contact with the part's recessed socket contact terminals by way of pneumatic actuation of a mechanical fixture.

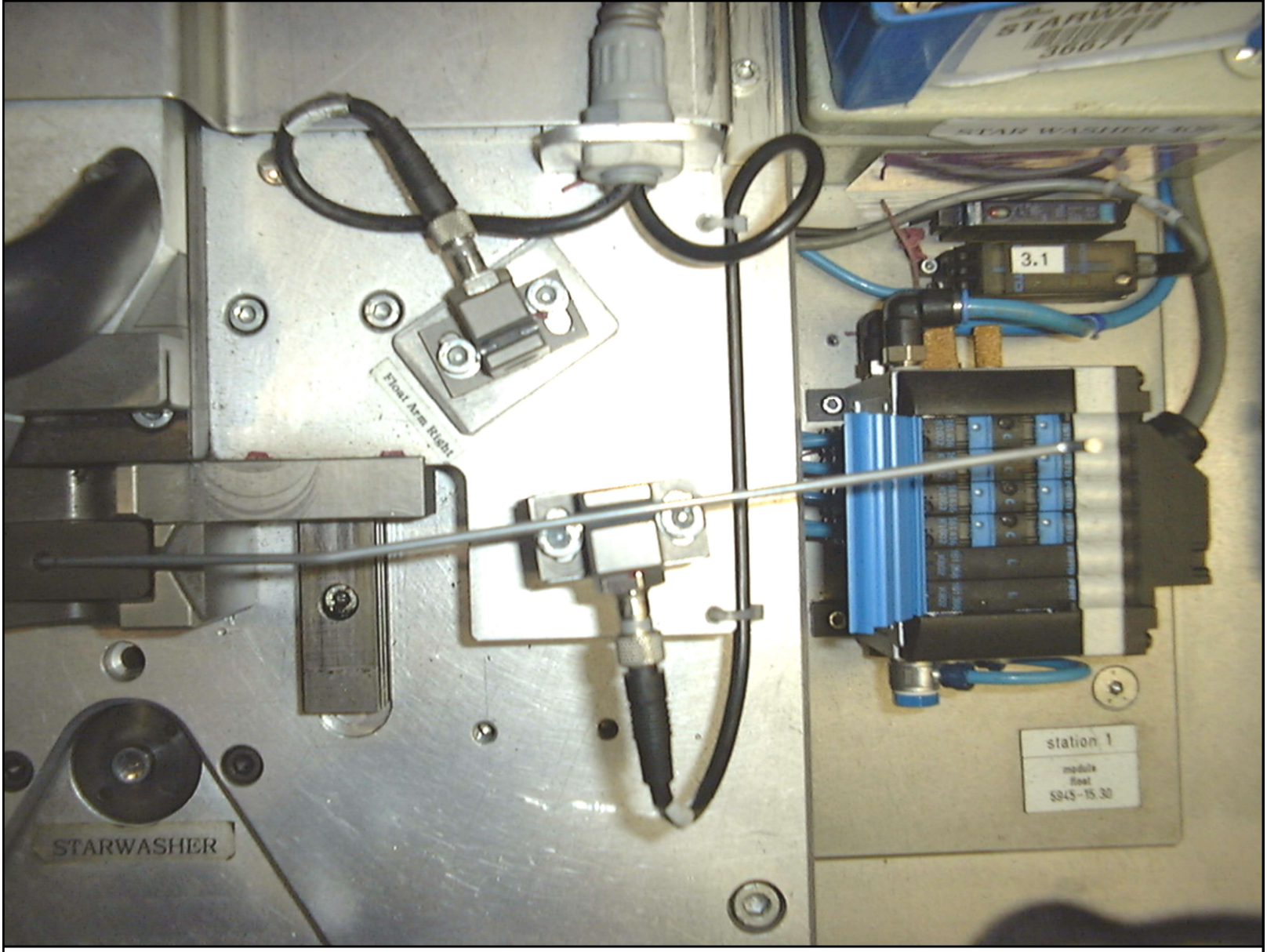
During my survey I observed that the recessed socket contact terminals did not always align itself exactly centered to the concaved test probes causing lateral stress on the inside surfaces of the spring loaded test probes. This mechanical misalignment was what was causing the accelerated deterioration and shortened life cycle of the test probes - eventually the failure mode was either breakage of the test probe or high internal contact surface electrical resistance resulting in false high resistance testing results - I tried to improve the repeat and reproducibility of the alignment of the test probe to recessed socket contact terminals, but this only resulted in an improvement of 50%.

I asked the manufacturing engineers who had overseen years previously the inception of this process why they used concaved test probes. To my surprise they didn't know why citing possibly that the concaved test probe would help correct any minor misalignment during operation.



To rectify the problem completely I simply replaced the test probe head from the concave design to a flush surfaced head design which was also a little larger in diameter. This change in design did not adversely affect test quality.

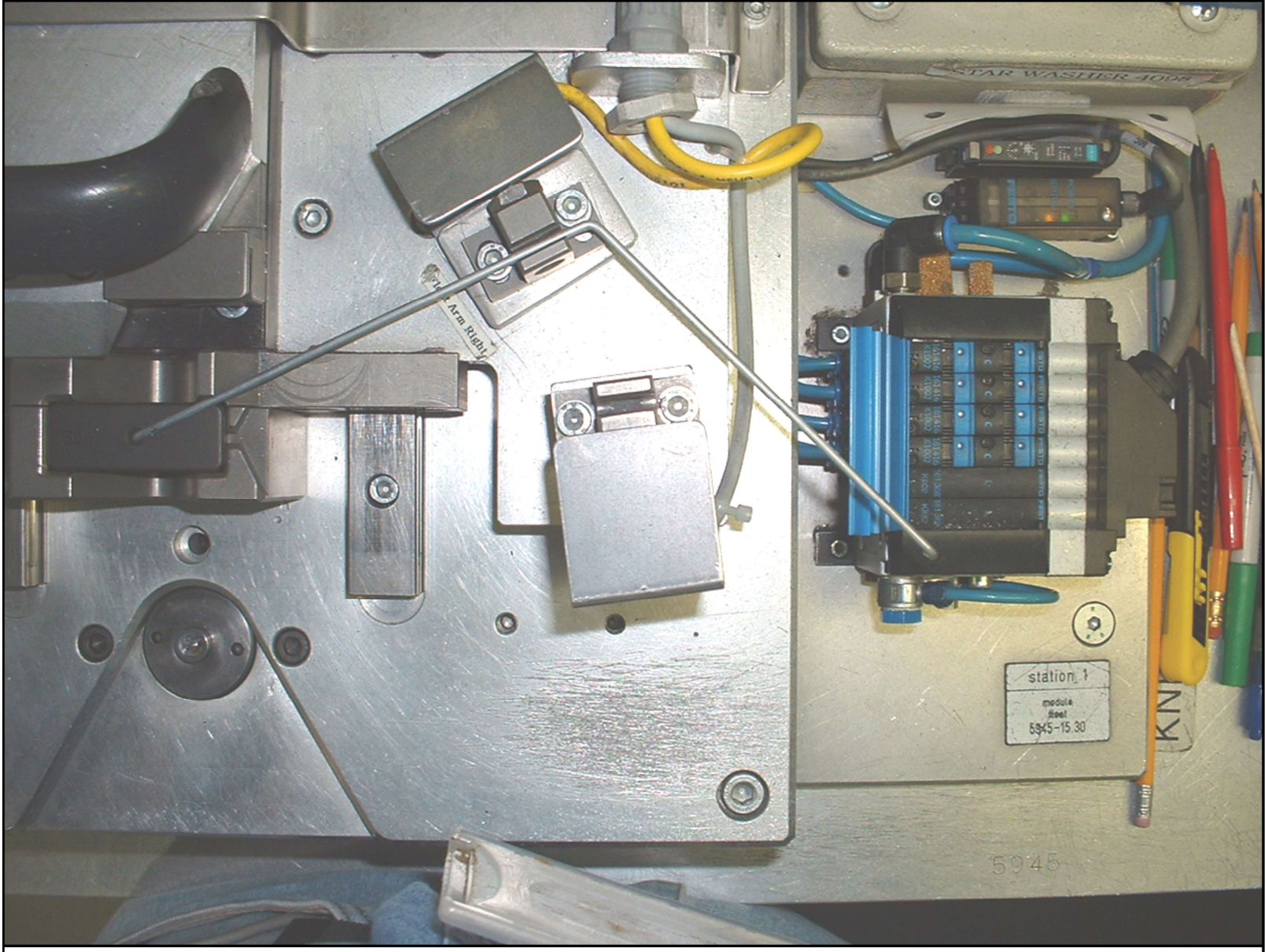
Now sight mechanical misalignment could be tolerated as there was no lateral force acting on the internal contact surfaces of the new flush surface head test probes (see replacement flush surface head test probe head design on right) This resulted in $11,000.00 in cost savings for the remaining three years of the product program.



Minor stoppages and idling account for much downtime which go unrecorded. Pictured is an assembly machine that is used to assemble a star waster retainer on to a gas tank level sender unit float arm. Part of the mistake proofing the process (Poke-Yoke) was present/absent component detectors and in this case proximately sensors were used to detect that the correct float arm was being used for the part type being made.

The operator of the machine occasionally would snag the cables to these proximately sensors breaking them from their electrical couplers. When this happened the entire cable had to be changed out. Asking the operator to be more careful does not fix a faulty process, so I installed mechanical protection shields to protect the cables from the operator accidentally snagging the float arms on them.

This problem never happened again. Another example of hitting singles…



Picture showing the mechanical protection shields installed.

Pictured is an electrically heated hot date stamp with pneumatic actuator. Repeated breakdowns with all machines that used this device accounted for 2 occurrences a month in which the process line would suffer an hour of interruption to production. The problem description was ‘date stamp not heating up’.

Again I used the P-M Analysis method to deal with this chronic problem for years before I joined the company. Upon investigation I found ‘how’ the failure occurred was ‘incomplete electrical continuity to heater elements to pass electrical current’.

Now the ‘why’ it occurred, quite simply the wrong type of coiled heater element wire was being used. It was not designed for tight coils and dynamic changes of state and in this case the movement of extension and retraction of the pneumatic actuator.

I conducted some research to alternative heater elements with specialized connector wires that could withstand tight coils and contraction and extension movement along the coil axis. I eventually found the wire I needed to eliminate this problem and had the wire custom manufactured to the heater element terminals.

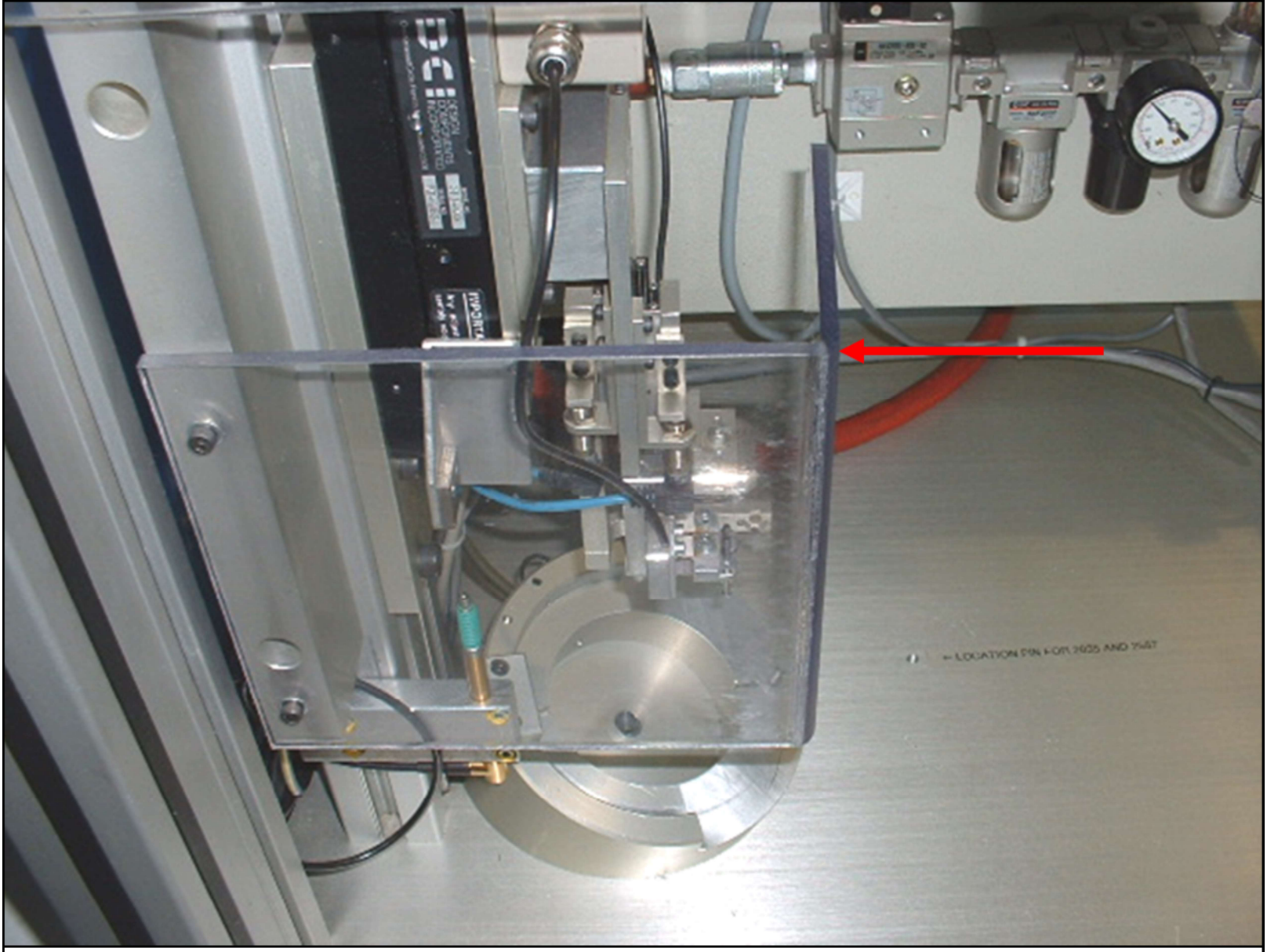
Extension of pneumatic actuator.

Pictured is the original heater element and connecting wires.

Improvement heater elements with specialized connector wires that could withstand tight coils and contraction and extension movement along the coil axis.

Mean time between failure - infinity …

I left the company 2 years after this improvement and all re-fitted date stamps actuators never had a single failure in that time.

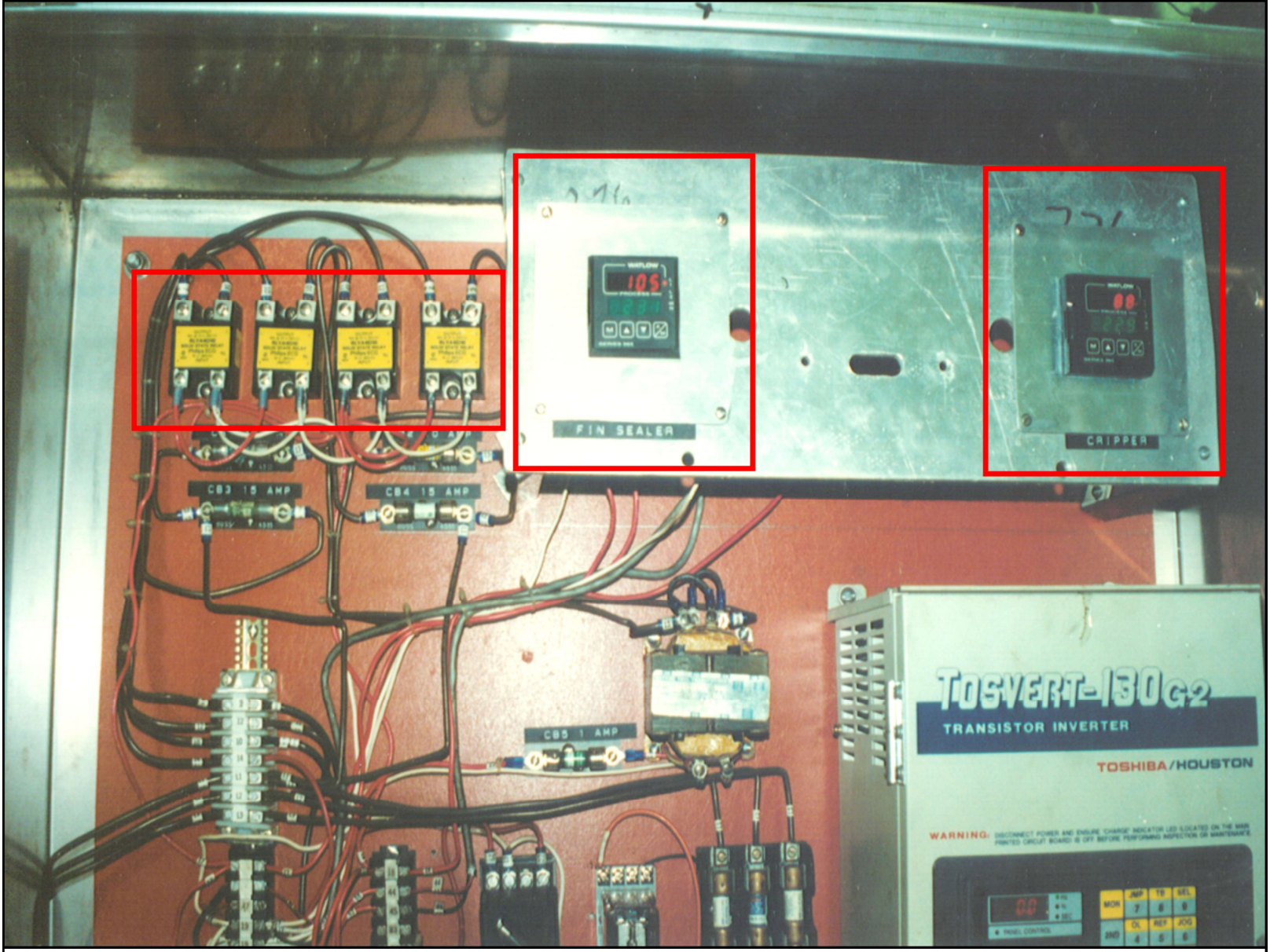


Fixing the system behind the problem…This is a picture of a final test machine which tested the operation range and readings of a gas tank level sender unit. On this application the operator while placing the part to be tested in the holding nest sometimes would accidently hit the part on two very sensitive strain gauges that measured the force of two electrical contacts. The strain gauges would then have to be re-calibrated.

I was perplexed as to why the strain gauges had to be re-calibrated so often, but after long and careful observation I saw what was happening. Veteran operators knew that the strain gauges where sensitive and were careful to avoid hitting them, novice operators new to the process were not aware of how sensitive these gauges were.

Asking the operator to be more careful does nothing to fix the system of design, so I made and installed a plastic guard to prevent any future accidental hitting with the part on the strain gauges.

Another problem fixed permanently…



This picture shows some electrical up-grading I carried out on a horizontal wrapper machine to improve its performance and stability.

I replaced the old style dry contacts contactors relays for the heater elements with solid state relays - 240V 1Ø A to B to C to A - and I changed out the old type of on/off heater controllers in exchange for PID controllers which gave much better temperature regulation.