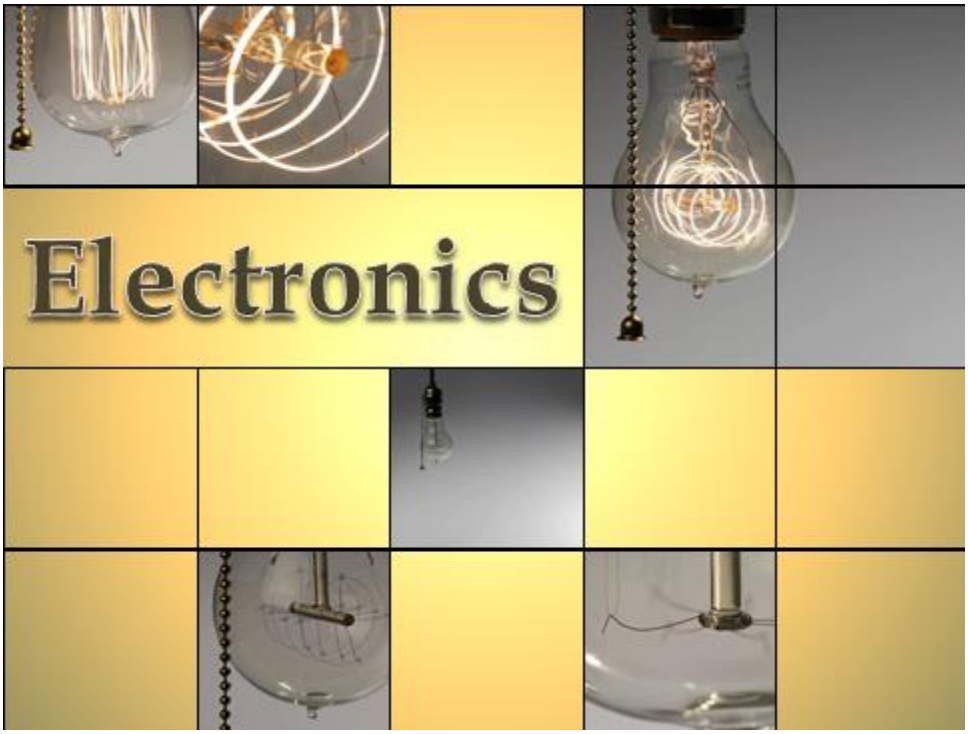

Five Points of Electronics Assembly:

Improve the Process Flow and Improve the Quality.

http://www.linkedin.com/pub/jerry-sowell/9a/867/9b6

Java7Red@gmail.com

As a quality professional, with experience within the electronics manufacturing industry, I have several techniques that I relied on to improve and maintain quality levels in the manufacturing environments in which I worked. My experience includes working both, as a quality assurance supervisor, and as a front line supervisor in a high volume electronics assembly facility. The techniques that I will describe here will be useful in many electronic assembly operations including small scale operations, and those that operate in a batch and queue mode. I write this article in the hope that it will be of help to anyone involved with electronics assembly, who needs to improve, and maintain a consistent high level of quality.

Therefore, we will focus on what you as an assembly supervisor, or engineering technician can do to improve the quality of the assembly operations that you are responsible for. By improving quality, I mean assuring the quality by means of a system the does not induce defects into units produced, and a

system that makes for immediate identification of potential quality issues.
To do this, you will need to improve the process flow, and improve the skills of the operators involved with assembly and testing. Now what are my techniques, or as I prefer to call them my "Five Points of Electronics Assembly", they are:

1) Time studies
2) Process flow (Bottlenecks)
3) Work instructions
4) Repair/rework
5) Check Sheets

In actuality, the term "Kaizen" or continuous improvement would encompass these five points as well as much more. But I believe that my five points are the down and dirty method that would accomplish your goal of quality improvement. The term "Kaizen" simply means the elimination of waste through incremental changes. That waste can be wasted motion by the assembler, or waste materials that clutter the assembly area, etc. The whole purpose of this article is to provide you with a simple plan to improve your assembly operations, and maintain a consistent high quality level.

So let's get started.

1. Time Studies

It is my experience that no quality improvement project can be initiated without a time study. Time studies are multi-purpose, and are at the heart of the improvement process. They are really time and motion studies that allow the technician the ability to observe, and determine the current state of the assembly operation, one work procedure, or work station at a time. The purpose of time and motion studies is not to pressure the worker into working faster, but to help improve the activities that take place at the workstation. By spending a proper amount of time observing a workstation you can ascertain the correct time standards for each task, and determine if the tasks assigned at any particular station can be performed in the allotted time (cycle time.) In addition, to observing the motions of the workers, you are also observing the movement of the product throughout assembly. The goal is to determine what impediments there are to smooth assembly flow. You may want to informally observe each station at first, to identify any possible issues, and make some preliminary corrective actions. But at some point you will need to pull out the stop watch, and perform a formal time study. Make sure to observe the workstation with more than one operator doing the job. If you have floater personnel, who are trained at that assembly station, be sure to observe them as well.

Now is the work moving to and from the assembly point within the allotted cycle time?

2. Process Flow

If the product is not arriving at the workstation, or leaving the workstation on time then you have a process flow issue, or "bottle neck" that needs to be remedied. Is the cause of the bottle neck that the workstation is overloaded, or is the assembler working out of sequence? Could it be that the ergonomic

design of the workstation can be improved, or is the tooling installed at this station functioning poorly? Is the area cluttered with materials which are encumbering the worker? You may discover that the design of the workstation is causing unnecessary motion on the part of the assembler, or that needed equipment is not placed in the right position, thus hindering smooth product flow. *The smoother the product flow the better the quality, and less rework routed to repair stations.*

It will become apparent that simple technical observation at each assembly point, and the recording of data and notes about what is observed yields a wealth of information. Time and motion studies when done correctly provides you with a clear understanding of your assembly operation, and what changes your may need to implement to improve the product flow. Therefore, by performing the time study we start the process of - **Balancing the Line!** - First and foremost by determining the accurate amount of time a task, when performed correctly, should take. Next you confirm that the tasks are distributed so that no one workstation is overloaded, and unable to perform within cycle time. You will also need to verify that the work instructions are accurate, and that the assemblers are performing the tasks within the proper sequence described in the instruction. You must identify all obstacles that hinder smooth line flow, and remove them by corrective actions. Also, you will need to determine what components and work materials are needed at the line, and in what quantities. Remember, there are many reasons why assembly operations become unbalanced, other than an increase, or decrease in production - It happens, and requires constant vigilance on the part of the supervisor. The better your process flow is the better your quality - Bet on it!

3. Work Instructions

Once you have corrected, or improved your line flow by the use of time and motion studies, and established the proper sequence of assemble, you can proceed to write or update the work instructions. A well written work procedure would also include any quality checks that the assembler would perform during each cycle. The instruction should include many of the following items:

- illustrations showing assembly methods, and assembly sequence
- simple and unambiguous verbiage describing assembly tasks
- calibration settings of test equipment installed at station
- torque settings for tooling
- limits for tolerances or specifications – (pass or fail)
- part numbers and quantities of components delivered to the line
- intervals for preventative workstation, or test equipment maintenance

One additional point I would like to make is, if the operator is working out of sequence to established work procedures there may be a logical reason. Maybe the work instruction is wrong and the worker is right. Sometimes under startup conditions, whenever a new product or new assembly system is introduced, the work instructions are written from a theoretical belief about what is the proper assembly method. Once the theoretical method is actually put to practice it is found to be wrong. Don't always assume the operator is wrong. I would encourage you to keep lines of communication between yourself, and the operators open and free flowing. You may find they know more than you.

4. **Repair / Rework**

In any assembly operation there are going to be repairs or adjustments to units that are found to be non-conforming, and do no pass the inspection points. But there will be fewer numbers of repairs if the line is balanced; the process flow is smooth, and the work instructions properly written. But in more than one assembly operation that I have observed, which had lower that optimal quality, defective units in the field were directly traceable to poor rework procedures. The rework was actually inducing a significant amount of defects into units that made it into the field.

Here I have to repeat myself - Balance the line first! Improve the line flow and eliminate all bottlenecks. Determine the proper work sequences, and confirm that assembly operators follow those procedures. Confirm the condition/calibration of all tooling and test equipment. With this all accomplished, your quality has already improved, and the number of line repairs reduced significantly. Now the method to improve the repair area differs somewhat from the assembly stations. At this point, you must be more hands-on, and perform some repairs yourself. By actually repairing the product yourself, you learn what defects can be induced, into the product, if the repair is performed improperly, and you'll gain insight into the relationship between line conditions and quality. Here are some other items that you may discover:

- What components are failing – remember that defective components in the field would have shown up somewhere in the process.
- Are repair technicians correctly diagnosing the faulty condition – It's inefficient and leads to poor quality if the repair tech does not correct the issue the first time, and must implement more than one repair to a unit.
- What workstations are contributing to your line repairs – again those stations will have to be re-observed as to what the issues are. Is the station still overloaded, or is there need for more training. Is the test equipment faulty, and out of calibration.
- Is the product being damaged in some way - misaligned equipment and worn tooling are top contributors to damaged units. The higher your production the quicker production equipment will wear.
- Are repair technicians following established procedures – as with the assembly operations, repair procedures should be confirmed, and that repair techs are following those procedures.
- Is the test equipment and tooling in the repair area in good condition and properly calibrated – these items should be checked frequently.

The repair area requires personnel with a high level of skill, and attention to detail. So spend a considerable amount of time, and learn the repair area as well, or better than the technicians you supervise. From your repair/rework stations you will observe quality trends as they develop, and be better able to implement countermeasures in real time.

5. **Check Sheets**

With your assemble and rework procedures established, proper line balancing achieved, and well written work instructions created, you will want to ensure a certain consistent operational level. You do this with check sheets. Check sheets are simply a list of items that you as the supervisor will check on a daily basis, preferably multiple times during the shift, like after each break. Check sheets will contain items such as tool and test equipment calibration checks. Also, certain visual checks that you perform at each work station to confirm that the operator is working in the proper sequence, and to established procedure as defined in the work instruction. You would also take a sampling of units for proper conformity to specifications. A good check sheet for a technician, or supervisor for his area of responsibility would take about 15-20 minutes to perform, and provides a good snap shot of the process at that instance in time. Later, if a quality issue did arise related to product non-conformity, and was traced to say a calibration issue with the test equipment, then the scope of the problem can be contained back to the last calibration check recorded in the check sheet. Whenever you rebalance the line, or change assembly methods in some way, then you will need to update the check sheets to the new process.

Summary:

There are many things that I did not include because I wanted to keep it simple. With that in mind, if you follow this simple guide your quality will stabilize and improve. Therefore, let's review my "Five Points" stated a little differently:

- **Observation** – Time and motion studies.
- **Implementation** - Changes to assembly methods, or countermeasures to ensure smooth process flow.
- **Documentation** – Update the work instructions and check sheets to reflect process changes.
- **Confirmation** – Verify through check sheets that operational procedures are being followed.
- **Hands on** – Work at those repair and assembly stations.

It all boils down to Keen observation, with the aid of time and motion studies, to gain a clear understanding of your process flow. This allows you to determine your bottlenecks, and eliminate the causes. Those items may be a cluttered work area, poorly written instructions, over loaded work stations, worn tooling, etc. Balance the line flow, then move on to your repair stations, and observe that area. The repair process will then point you back to the assemble area, and the cycle repeats. This is how I assure a high level of quality - through a continuous cycle of observation - implementing improvements or countermeasures - documenting those changes in the work instructions, and confirming that the process is under control, and operating to established procedures with the use of check sheets. Remember, the best way to learn the process is to perform some of the work yourself. Spend time at the repair stations, and even work for a while at the assembly stations.