

Loose Nuts and Setpoints



A paper on observations and discussions with
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NSW November 2003

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Adjustment – Friend of Foe?

Equipment has a range of mechanical points of adjustment (POAs). These include:

1. Adjustment related to size and configuration changes
2. Adjustment related to wear of the machine
3. Adjustment at installation
4. Adjustment to assist the Supplier in assembling the equipment
5. Adjustment to allow for general usage of a machine outside its current scope of use. Eg. A packing machine could do both Bricks and Baseball bats. If you are in the Brick business then the adjustments related to Baseball bats are of little interest to your business
6. Adjustments that are no longer required at all but have been superseded as equipment is modified.

No doubt there are a range of others.

Adjustments are an excellent way to get an equipment set up to standard (ie. Manufacturers specification). They also, however, can be used very effectively to get equipment out of standard.

How many times have we seen a situation at shift change where an operator takes over a machine or a line and the first action they take is to change settings even though the machine has been performing well over the previous shift?

How many times have we walked past equipment where guards on machine components have nuts missing, holes in machine frames where something should be or places where things should be attached and are not? Were these issues deliberately left like this or have things gone missing and we just don't know where or why they have.

In industry like foods and pharmaceuticals situations like this can be catastrophic and put business at risk through potential public health risk.

So what can be done to overcome these issues?

At a recent visit to Rheem Australia's Rydalmere Plant where a wide range of hot water heaters are manufactured an interesting program was observed and this paper describes an initiative Rheem has put in place to minimise such occurrences.

The Process used has a number of objectives:

1. Elimination of Adjustment that is not necessary. This is aimed at ensuring that people don't put the machine out of spec – albeit with the

- best of intentions. Typically more than 50% of the adjustments can be taken out of the machine
2. Ensuring that all the remaining adjustments are simple to carry out and are repeatable. I.e. Lets get rid of the pieces of paper that people carry around with them with the 'tried and tested' settings.
 3. Ensuring that the machine can be inspected (preferably while it is running) and that this inspection will reveal that the machine is set correctly.

These points are all ideals but will help to explain the logic behind the process that is used.

The approach to achieving these outcomes can be divided into 3 Broad categories viz. Find, Eliminate and Simplify

Find

A team of people must be put together and this team should come from Production and Maintenance. The Team must be well lead and Engineers tend to be good candidates for this job. This stage requires little understanding of the machine and in some cases, people who are less familiar with the function of the equipment are more useful as they will not take shortcuts and will question. People such as apprentices, process engineers, operators and students are ideal. In the main, at this stage, keep your equipment 'experts' at a distance from the process – other than using them in an advisory position like telling you where all the 'secret' points of adjustment are.

The first stage of the project involves locating all POAs. I must stress all. One needs to be rigorous in this process and leave no piece of the machine out of the process.

Begin at a logical starting point on the equipment and work systematically through the machine. If we were to use a Bottle Filler as an example, the team would agree on the start and the end of the machine. This could be from the Infeed Conveyor, Feeding the bottles into the Filler, through the Filling Heads and to the end of the Outfeed Conveyor.

Using the example of a Bottle Filler, the team starts at the Infeed Conveyor and looks for all POAs. On the infeed one is likely to find, guide rail adjustments, height adjustments, proximity sensors that can be adjusted in various directions, adjustments used to set up the heights of the conveyors, adjustments on sprockets, chain tensioners, (slotted) positions on the motor gearbox. Quite quickly it will be found there are numerous POAs each part of the selected equipment and several hundred on a machine is not uncommon.

The temptation at this stage is for the team to start saying, "But surely we don't need to worry about this as no one would ever change this!" If this line of thought is allowed to continue, the project will not deliver it's full potential.

As each POA is found, it must be physically marked on the machine and also catalogued in a Spreadsheet. This is done as each of the points of adjustment are found. A simple system can be used to do this, eg. The Infeed Conveyor can have the Prefix I and as one moves through the Infeed Conveyor from start to finish, the Identifiers I1, I2, I3... can be written next to the point of adjustment. It is preferable that the numbers can be easily viewed by walking along the machine. This is mostly possible, even if the numbers are written on guards and covers that obscure the equipment.

The table might look something like this:

ID	Section	Description	Function
I1	Infeed	Guide Rail Height	Accommodate different bottle heights
I2	Infeed	Bottle Sensor	Check to see if bottle present
I3	Infeed	Chain Tensioner	Adjusts for wear in the drive chain
I4	Infeed	Slotted motor mount bolts	Used at initial installation for mounting drive motor

The team should be challenged to find as many points of adjustment until every possible one has been found. There are some unusual points of adjustment such as fine adjustment used when installing the machine so that it lines up with other equipment that it feeds. Again, these must be identified.

Eliminate, Eliminate, Eliminate

Once the Spreadsheet is completed, the Team must then involve a range of people to identify which of the adjustments can be eliminated all together.

This stage now requires an understanding of the machine and process being considered. Added to the core team should now be the equipment experts. Be sure to have people who understand the Process, the Equipment, Maintenance and Operation at this stage. Using the spreadsheet, each POA is reviewed and every effort is made to agree on fixing as many as possible. Sometimes this make people very uneasy as they may prefer to have as many points to change as possible and will be unsure as to the usefulness of the project being carried out.

It is not uncommon that up to 50% of points of adjustment are not needed unless one is relocating the equipment or changing the function of the equipment.

Using this new information, lock up each point of adjustment so that adjustment will require modification to the equipment. Pinning, tacking, welding the newly identified fixed points are typical activities carried out at this stage.

Along with this, never leave open holes where nuts and bolts once resided. fill and grind flush to eliminate doubt.

Once the entire machine is done, the Team is ready for the next stage. Don't be surprised if, the benefits start to flow from the project at this stage. Already the improved knowledge of the equipment and processes will start to deliver benefits. Our table now looks like this:

ID	Section	Description	Function	Category
I1	Infeed	Guide Rail Height	Accommodate different bottle heights	
I2	Infeed	Bottle Sensor	Check to see if bottle present	
I3	Infeed	Chain Tensioner	Adjusts for wear in the drive chain	
!3	Infeed	Slotted motor mount bolts	Used at initial installation for mounting drive motor	Fixed

Many of the POAs are Maintenance related and these should be identified as such. A robust label with an appropriate Symbol is sufficient. Eg. The letter "M" marked at each point of adjustment could be one approach used. The benefits of this stage, although not the aim of this project, can include the Maintenance department ensuring that each of the "M" points have properly documented Preventive/Corrective Maintenance procedures associated with them. The table now looks like this:

ID	Section	Description	Function	Category
I1	Infeed	Guide Rail Height	Accommodate different bottle heights	
I2	Infeed	Bottle Sensor	Check to see if bottle present	
I3	Infeed	Chain Tensioner	Adjusts for wear in the drive chain	Maintenance
!3	Infeed	Slotted motor mount bolts	Used at initial installation for mounting drive motor	Fixed

Simplify

This step is based on a few fundamental beliefs about manufacturing and these include:

1. There should be no private information in Manufacturing. By private information, I mean information that is not readily available to all Employees who need it.
2. Not everyone is comfortable with numbers
3. Not everyone is literate in English or can read Engineering Drawings

Based on this, the Simplify step first classifies all remaining POAS on a Scale of 1 to 7 depending on how the current manner of adjusting rates. Once this is done, the Project Team works to migrate as many POAs as close to 10, on the Scale, as is possible.

The Scale can be developed internally. 1 is regarded as the least ideal stage and 7 is the ideal stage with different ways of changing POAs in between. Keeping in mind the 3 fundamental beliefs listed about, here is a proposed way of scoring POAs.

1. **Setting by feel, judgement, eye.** This has got to be the worst sort of setting as it has infinite variation and has no science associated with it. Where part of the process have to be continually adjusted, PID control,

is more appropriate – however this is not always possible. This class of POA must be eliminated if possible.

2. **Setting by memory or information kept on various bits of paper.** This is certainly better than the first type but they are an example of private information
3. **Setting using measuring devices from available Manuals.** This is an improvement however, errors of measurement should be kept in mind and not everyone is comfortable working through a technical manual when faced with tables, graphs and engineering drawings.
4. **Setting using graduated devices on the Machine.** These now make the information available for all to see, allow one to inspect the machine without stopping it. One word of caution, these can be rendered useless by lack of maintenance and calibration. One will often see counters on machine that count the number of turns on a handle and the counter is either badly damaged or the mechanical linkage is either stretched or worn.
5. **Setting using jigs/templates.** This overcomes the numeracy and literacy issue and provided the jigs/templates are well marked and readily available, this is an improvement.
6. **Colour coded setting points.** This can be a highly effective way of marking the settings on a machine. Gone are the literacy, numeracy and ‘private information’ issues of other types of settings. Typically people will use different colours for different size changes and these can often be inspected while the machine is running.
7. **Drop in change parts.** This, in effect, is a close as one can get to having a “Fixed but Changeable” POA. Much good work can be done in this area using difference coloured plastics and making these fit in with the Single Minute Exchange of Die (SMED) approach.

ID	Section	Description	Function	Category
I1	Infeed	Guide Rail Height	Accommodate different bottle heights	4
I2	Infeed	Bottle Sensor	Check to see if bottle present	1
I3	Infeed	Chain Tensioner	Adjusts for wear in the drive chain	Maintenance
I3	Infeed	Slotted motor mount bolts	Used at initial installation for mounting drive motor	Fixed

Fear of Change

It is crucial that people understand that there can be enormous resistance to this type of project. Most of this is based on fear.

People who have the information often use this information as a type of organizational currency whereby they feel that for as long as they have ‘private information’ they will be required.

Others will be worried by the reduction in their ability to ‘fine tune’ the equipment and they will no longer have the ability to fiddle with the equipment.

The logic behind using a team based approach is that we take people along with change and get their buy in.

Finally

Experience in this area over the years have shown spectacular results. They have delivered vertical start ups* after changeovers, forced the suppliers of materials to stay within spec and have removed much stress from the lives of the employees.

Note*: A vertical start up is when, after a changeover, the first part/product coming out of the equipment is correct and there is not further adjustment required.

For those wishing to try out these ideas, a project can be piloted in a small section of the plant. TPM small group improvement activities is an ideal, although not essential, vehicle for delivering the outcomes described.

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