

When the machine is set up with its tooling, parts are run and a significant number of consecutive pieces are measured. This chart depicts the M/3200 Frame, Operation 100. Twenty-eight (28) consecutive pieces were taken, measured and plotted. The purpose of this study is to determine whether or not the operation is controllable. The operation by definition is controllable, on a single spindle machine, if the overall spread of these measurements falls in an eight standard deviation band. The standard deviation can be no larger than total tolerance divided by eight. On a multiple spindle machine, the standard deviation can be no larger than the overall tolerance divided by ten. However, the sample size on multiple spindle machines is about half the sample size on the single spindle machines.

This plotted pattern of measurements could fall outside the tolerance band of the dimension and still be controllable if the machine is capable of being adjusted so the pattern falls in proper relationship to the tolerance. If the machine study is made and is decided to be controllable, it is turned over to Production. If it is found not controllable, one of two things takes place. First, a program is outlined to alter the machine or the tooling so that the operation can be made controllable. If, however, it is found that the operation cannot be made controllable, a 100% gaging procedure is established to make sure that the parts coming off the machine are within the tolerance band.

The gaging procedure is established after the machine study is completed considering the following items:

1. How critical is the operation to the function of the gun both for safety and reliability?
2. How many parts are produced per cutter grind?
3. The equipment is studied from the standpoint of how difficult it is to maintain controllability because of the nature of the machine itself.
4. The tolerance band, whether it is wide or narrow also has a bearing on the gaging frequency.
5. How far along the parts are in the process. For example, if a part was 95% of the operations finished, more pieces are checked because there is more money invested in the part at that time.

This particular operation was found to be controllable. The gaging frequency after considering all of these items was established at 3 pieces out of 60, plus a visual examination for finish.

The gaging procedures that we have in Production vary from 100% to 3 in 150 pieces.

Once the machine study is completed, the operation is turned over to production. During the machine study, Production and Process Engineering work hand in hand to establish the quality of the component. (It must be understood that P E & C is a section in Production that acts as the intermediate step between R & D and the Production Floor).

When the operation is released to Production, this chart (Exhibit 10) shows a typical sequence of operations. Incoming work comes to a machine, group of machines, or an operation. Assuming everything goes all right, completed work falls into a sub-lot, (the size of the sub-lot is determined by the gaging frequency. For example, in this