20 MULTI-VARI ANALYSIS

Description

Multi-Vari Analysis is a graphical tool used in problem solving to identify sources of variance.

Purpose

Multi-Vari is used to identify the largest sources of measurement variation. It is a particularly useful diagnostic technique when trying to understand the major cause of manufacturing variation.

Benefits

Multi-Vari displays patterns of change in measurement. It helps focus problem-solving efforts on items with the most significant effect by highlighting groups of measurements with the widest measurement variation.

Implementation

To gain maximum benefit from Multi-Vari, you must first understand the possible causes of variation. A carefully planned strategy of grouping sets of measurements is the first step. Start with the smallest possible family and work to the largest.

For example, families for measuring variation in diameter on a valve shaft might be these:

1.Measurement to measurement same diameter – is the measurement system itself bad?

2.Diameter to diameter same end – is the part oval?

3.End to end same valve – does the part have taper?

4.Valve to valve same time – are there parallel paths, material or station variance, etc.?

5.Time to time – are there tool wear or machine setup differences?

The samples measured should be taken in order of production and not randomly. Typically, samples within a family are taken consecutively. At least three samples per family and three families should be measured and measurement results should encompass at least 80percent of the full range of variance experienced. The family with the largest range of variance contains the suspected root cause.

Process Flow

It is important to take notes and make observations of the process while you are selecting parts. Yet remember, Multi-Vari is a clue-generating tool and therefore we should only record elements of the process and not change them. An understanding of process elements that correlate to the Multi-Vari results will be valuable later in confirming the root cause through designed experiments where process elements can be systematically changed.

Example

The chart below illustrates Multi-Vari for a valve diameter problem.

The chart shows measurement values for three valve samples (#1, #2, #3) that were taken from production at five times during the day (7:00am, 9:00am, 11:00am, 11:30am, and 1:30pm). Measurements of the maximum [1] and minimum [2] diameter were recorded for both ends of the valve (C= cut end, F=Free end).

In this example, the largest family of variance is clearly time-to-time. Measurements trend from 7:00am through 11:00am and then shift at 11:30am. Notes taken during the study showed that suspects are a temperature increase during operation and a refill of the coolant reservoir at 7:00am start-up and again after break at 11:30.

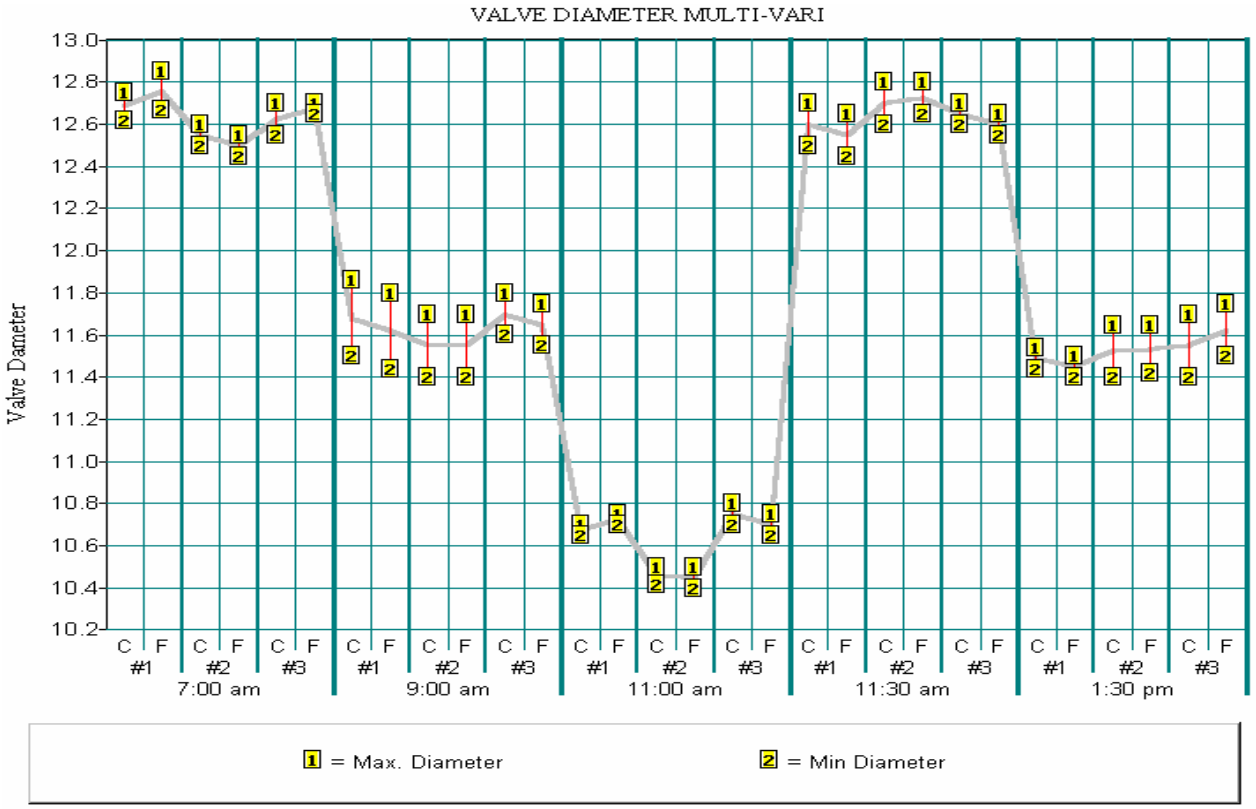

Figure 20.1. Multi-Vari Plot

General Comments

The Multi-Vari practitioners must ensure that they are using an effective measurement system previously verified by an Isoplot® or Gage R&R.

References

De Mast, Jeroen; Roes, Kit C.B.; and Does, Ronald J.M.M. *The Multi-Vari Chart: A Systematic Approach*

Perez-Wilson, Mario. *Multi-Vari Chart & Analysis: A Pre-experimentation Technique.*