



## Zone Control Charts

by John J. Flaig, Ph.D.

The zone control chart is a control chart that partitions the normal process distribution into regions and assigns to each region a score. Traditionally, the normal process distribution has been partitioned as follows:

Zone	Score
Centerline	0
Between center and one sigma	1
Between one and two sigma	2
Between two and three sigma	4
Beyond three sigma	8

This is illustrated in Figure 1.

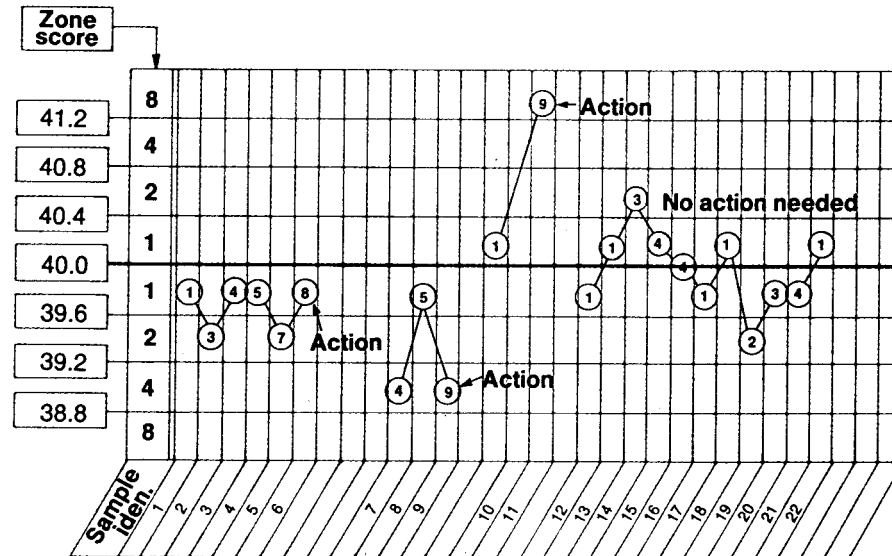


Figure 1. Zone Control Chart

The chart starts out with current score of zero and a cumulative score of zero. As additional observations are made the cumulative score is adjusted as follows:



1. If observation (i) and observation (i-1) are on different sides of the centerline, then the cumulative score at (i) is set to the zone score at (i).
2. If observation (i) and observation (i-1) are both on the same side of the centerline, then add the current score at (i) to the cumulative score at (i-1). Note, that a point that lands on the centerline does NOT reset the cumulative score.
3. If the cumulative score reaches eight, then an out-of-control signal is generated. The practitioner should check for assignable causes and reset the cumulative score to zero.

Zone control charting methods have been advocated by a number of authors such as Jaehn [1987], Reynolds [1971] and Roberts [1966]. Initially, the main advantage of zone control charting methods over the standard Shewhart approach was thought to lie in the simplicity of implementation. Recall that for Shewhart charts to be most effective, the user must learn to apply four “runs rules” to the data [Western Electric, 1956]. Recognition of “unusual” data patterns then allows the user to conclude that an out-of-control condition exists. However, with zone control charts the operator merely adds integers until the cumulative score reaches the signal point. The user friendliness of zone control charts becomes quite apparent in situations where there is a high labor turnover rate or operators are poorly educated. In such cases using pattern test methods effectively leads to a continual operator training program and performance efficiencies that are usually far below the theoretical levels reported in the literature.

Though it was readily apparent that zone charts were easier to use they were criticized for their effectiveness. Specifically, the in-control average run length (ARL) was about 40% that of a Shewhart chart [Homer, 1988]. In response to this criticism Jaehn [1989] offered a modification (given above) of his original zone scoring scheme. An evaluation of the modification by Davis, Homer and Woodall [1990] showed that the average run length performance of the new chart is slightly better to the Shewhart chart using the Western Electric runs rules.



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So if you have an application using manual control charts, you might want to consider switching to zone charts. They will prove to be easier to maintain and more effective than the classical Shewhart charts.

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