InfinityQS® SPC Pocket Card

P_p and P_{pk} Fallout Rates

Calculated Capability Ratio	P_p Fallout (both sides combined)	P_{pk} Fallout (one side only)
0.50	133,620	66,810
0.60	71,860	35,930
0.70	35,730	17,865
0.80	16,396	8,198
0.90	6,934	3,467
1.00	2,700	1,350
1.10	966	483
1.20	318	159
1.30	96	48
1.40	26	13
1.50	7	3
1.60	2	1
1.70	0.340	0.170
1.80	0.060	0.030
1.90	0.012	0.006
2.00	0.002	0.001

Fallout rates expressed in PPM (parts per million)

Control Chart Constants

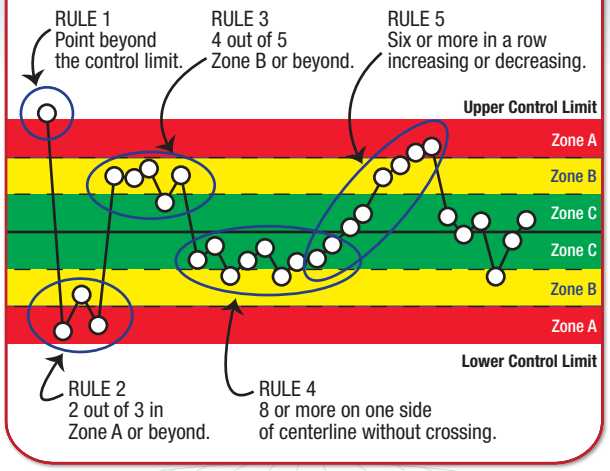
$\bar{X}$ and R Control Charts

n	A_2	D_3	D_4	d_2
1	2.660	-	-	-
2	1.880	0	3.267	1.128
3	1.023	0	2.574	1.693
4	0.729	0	2.282	2.059
5	0.577	0	2.114	2.326
6	0.483	0	2.004	2.534
7	0.419	0.076	1.924	2.704
8	0.373	0.136	1.864	2.847
9	0.337	0.184	1.816	2.970
10	0.308	0.223	1.777	3.078
11	0.285	0.256	1.744	3.173
12	0.266	0.283	1.717	3.258

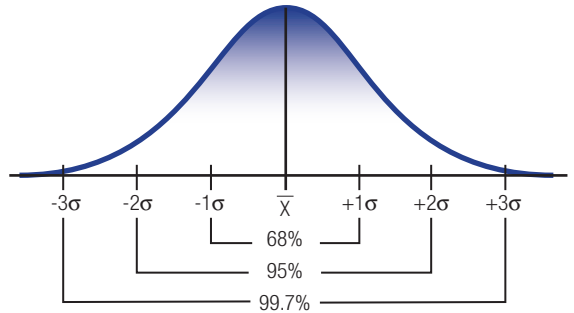
$\bar{X}$ and S Control Charts

n	A_3	B_3	B_4	c_4
10	0.975	0.284	1.716	0.9727
11	0.927	0.321	1.679	0.9754
12	0.886	0.354	1.646	0.9776
13	0.850	0.382	1.618	0.9794
14	0.817	0.406	1.594	0.9810
15	0.789	0.428	1.572	0.9823
16	0.763	0.448	1.552	0.9835
17	0.739	0.466	1.534	0.9845
18	0.718	0.482	1.518	0.9854
19	0.698	0.497	1.503	0.9862
20	0.680	0.510	1.490	0.9869
21	0.663	0.523	1.477	0.9876
22	0.647	0.534	1.466	0.9882
23	0.633	0.545	1.455	0.9887
24	0.619	0.555	1.445	0.9892
25	0.606	0.565	1.435	0.9896

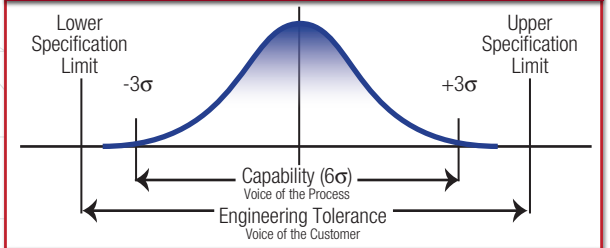
Special Cause Patterns



Empirical Rule



Capability Study



Capability Formulas

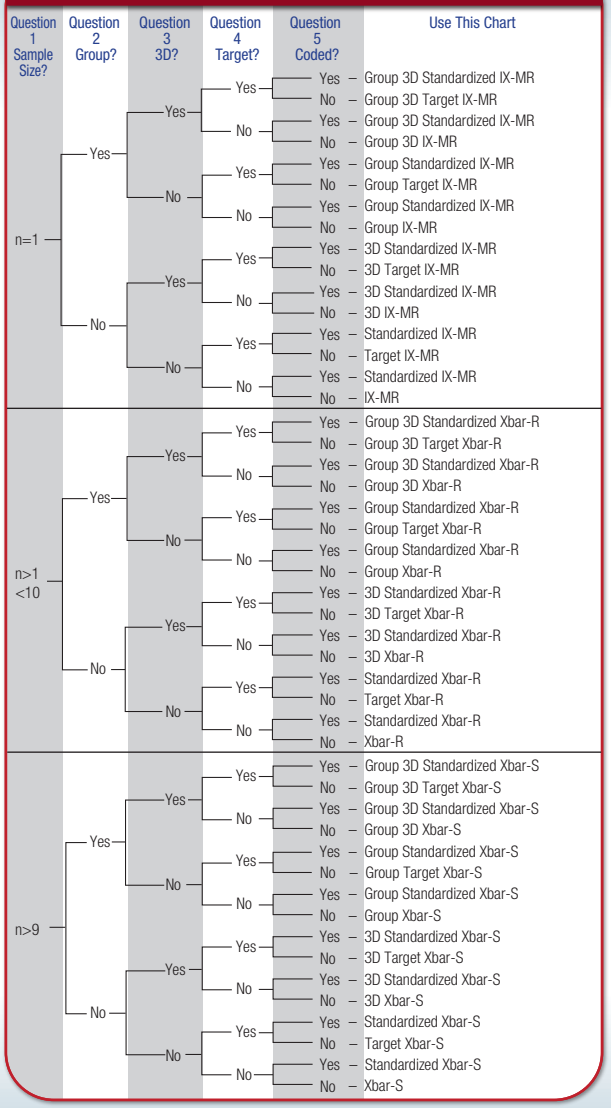
$$P_{pl} = \frac{\bar{X} - LSL}{3s} \qquad C_{pl} = \frac{\hat{\mu} - LSL}{3\hat{\sigma}} \qquad \bar{X} = \frac{\sum X}{n}$$

$$s = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}}$$

$$P_{pu} = \frac{USL - \bar{X}}{3s} \qquad C_{pu} = \frac{USL - \hat{\mu}}{3\hat{\sigma}} \qquad \hat{\sigma} = \frac{\bar{R}}{d_2}$$

$$P_p = \frac{USL - LSL}{6s} \qquad C_p = \frac{USL - LSL}{6\hat{\sigma}} \qquad \hat{\mu} = \text{Estimated population mean}$$

Variable Data Control Chart Selection Tree



InfinityQS Supports All These Variables Control Charts And Many More

Decision Tree Definitions

Data Type: There are two types of attribute data - defects and defectives. Defects data are count data and are described with a Poisson distribution. Counting the number of visual blemishes on a part or the number of support calls received in an hour are examples of defects data. Defectives data are pass/fail in nature.The number of rejected parts in a lot is an example of defective data. Defectives data are described with a binomial distribution.

Sample Size: The number of items in a single subgroup.

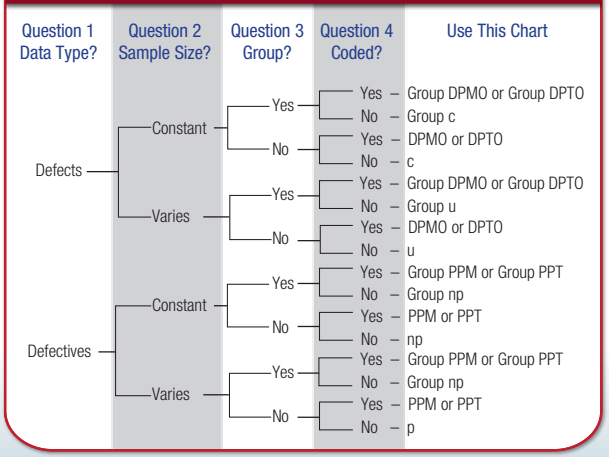
Group: Group processing is required when desiring to combine multiple process streams on the same chart. Plotting the output from multiple fill heads, a multi-cavity mold or multiple lines are classic examples for using Group charts.

3D: Used when measuring within-piece and piece-to-piece variation. Examples include measuring a spacer thickness in multiple places or measuring a bore diameter in three places to test for out-of-roundness.

Target: This processing is required when combining characteristics on the same chart that have different nominal or target values.

Coded: This processing is required when combining characteristics on the same chart that are of different units of measure, different expected levels of variation or different expected fallout rates.

Attribute Data Control Chart Selection Tree



InfinityQS Supports All These Variables Control Charts And Many More

Control Chart Formulas

Variables Control Charts

Chart Type	Centerline	Control Limits	Estimate of Sigma
$\bar{X}$ and R	$\bar{\bar{X}} = \frac{\sum \bar{X}}{k}$ $\bar{R} = \frac{\sum R}{k}$	$UCL_{\bar{X}} = \bar{\bar{X}} + A_2 \bar{R}$ $LCL_{\bar{X}} = \bar{\bar{X}} - A_2 \bar{R}$ $UCL_R = D_4 \bar{R}$ $LCL_R = D_3 \bar{R}$	$\bar{R} / d_2$
IX and MR	$\overline{IX} = \frac{\sum IX}{k}$ $\overline{MR} = \frac{\sum MR}{k-1}$	$UCL_{IX} = \overline{IX} + A_2 \overline{MR}$ $LCL_{IX} = \overline{IX} - A_2 \overline{MR}$ $UCL_{MR} = D_4 \overline{MR}$ $LCL_{MR} = 0$	$\overline{MR} / d_2$
$\bar{X}$ and s	$\bar{\bar{X}} = \frac{\sum \bar{X}}{k}$ $\bar{s} = \frac{\sum s}{k}$	$UCL_{\bar{X}} = \bar{\bar{X}} + A_3 \bar{s}$ $LCL_{\bar{X}} = \bar{\bar{X}} - A_3 \bar{s}$ $UCL_s = B_4 \bar{s}$ $LCL_s = B_3 \bar{s}$	$\bar{s} / c_4$

Attribute Control Charts

Chart Type	Centerline	Control Limits	Estimate of Sigma
p	$\bar{p} = \frac{\sum p}{k}$	$UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$ $LCL_p = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	$\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$
np	$n\bar{p} = \frac{\sum np}{k}$	$UCL_{np} = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$ $LCL_{np} = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$	$\sqrt{n\bar{p}(1-\bar{p})}$
c	$\bar{c} = \frac{\sum c}{k}$	$UCL_c = \bar{c} + 3\sqrt{\bar{c}}$ $LCL_c = \bar{c} - 3\sqrt{\bar{c}}$	$\sqrt{\bar{c}}$
u	$\bar{u} = \frac{\sum u}{k}$	$UCL_u = \bar{u} + 3\sqrt{\frac{\bar{u}}{n}}$ $LCL_u = \bar{u} - 3\sqrt{\frac{\bar{u}}{n}}$	$\sqrt{\frac{\bar{u}}{n}}$