

Process Capability Cp Cpk Pp Ppk

How-to guide: what the workbook does, how to use it and what every number means.

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Process Capability Cp Cpk Pp Ppk

Enter a subgrouped capability study and get Cp, Cpk, Pp, Ppk, a histogram against the specification and observed and expected ppm out of spec.

For: Quality engineers, supplier quality engineers, process engineers and machine shop owners preparing PPAP or customer capability evidence.

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Quick start

1. On Setup, name the characteristic and unit, type the lower and upper specification limits, the subgroup size and your customer's required Cpk and Ppk.
2. On Measurements, add one row per subgroup with its readings in production order (25 subgroups of 5 is the usual study).
3. Fix anything the Check column names, and confirm on an SPC chart that the process is stable before you quote the indices.
4. Open the Dashboard: the tiles give Cp, Cpk, Pp and Ppk against the requirement; the histogram shows where the parts fall in the tolerance.

What is in the workbook

Start Here	Read this first: what the workbook does and how to use it.
Setup	The characteristic, its specification limits, the subgroup size and your customer's requirements.
Measurements	One row per subgroup of consecutive parts, in production order.
Dashboard	Cp, Cpk, Pp and Ppk against your requirement, the histogram against the specification, and ppm out of spec.
Method	How every number is calculated, with assumptions, limits and sources.
Verify	Self-check: the workbook's formulas recomputed on fixed inputs against an independent reference.

What each number means

Quantity	How it is calculated	Units
Mean and range (per subgroup)	Average and largest minus smallest of the readings; blank unless exactly n readings.	unit
Out of spec (per subgroup)	Readings below the LSL or above the USL.	readings
Overall mean	Average of every reading in the table.	unit

Quantity	How it is calculated	Units
Within sigma	R-bar / d2: average subgroup range over d2 for the subgroup size (2.326 for n = 5).	unit
Overall sigma	Sample standard deviation of every reading (n - 1 in the denominator, STDEV.S).	unit
Cp and Pp	(USL - LSL) / (6 x sigma), with the within sigma for Cp and the overall sigma for Pp.	index
Cpk and Ppk	Smaller of (USL - mean) / (3 sigma) and (mean - LSL) / (3 sigma), each side shown separately (CPU, CPL, PPU, PPL).	index
Observed ppm	Readings outside the specification / readings x 1,000,000.	ppm
Expected ppm (est.)	Normal model with the overall mean and sigma: $(P(x < LSL) + P(x > USL)) \times 1,000,000$, using NORM.DIST.	ppm
Histogram	Twenty bins of (USL - LSL) / 20 across the tolerance (the last includes the USL), plus one bin for every reading below the LSL and one above the USL. Counts by COUNTIF(S); the normal fit is readings x the normal probability of each bin.	readings
Status	On target at or above the requirement, Near target within 5% below it, otherwise Below target.	words

Assumptions, limitations, sources and the self-check (the Verify sheet, which recomputes the workbook's formulas on fixed test inputs) are in the workbook. The last page shows the Dashboard with the example data for Kestrel Precision, a fictional business.

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Engineering estimates for planning and improvement work. Verify the results against your own process, data and standards before you rely on them.

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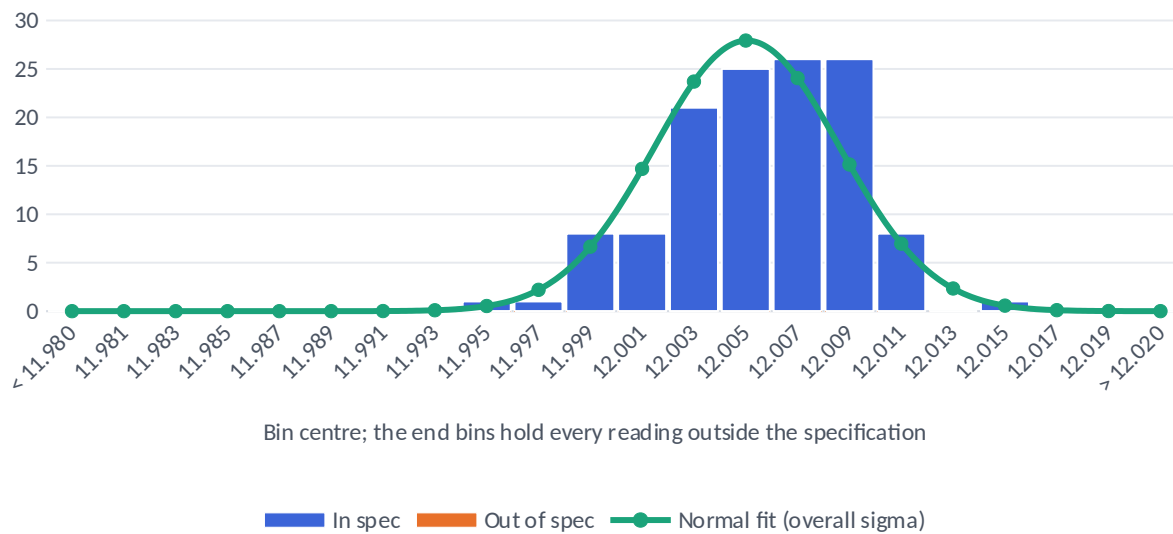
Cp, Cpk, Pp and Ppk against your requirement, the histogram against the specification, and ppm out of spec.

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Shaft OD, grind OP40 (example) | Kestrel Precision (example) | spec 11.980 to 12.020 mm | 125 readings

CPK (WITHIN)	PPK (OVERALL)	CP (WITHIN, IF CENTRED)	PP (OVERALL, IF CENTRED)
1.65	1.41	2.20	1.89
Target 1.33	Target 1.67	Target 1.33	Target 1.67
On target	Below target	On target	On target

Histogram against the specification



Indices against the requirement

