

X-bar and R control chart — bore diameter, part 4471

All records

SUBGROUPS CHARTED
11
1 excluded as a known special cause · 20 to 25 before the limits settle

PROCESS MEAN $\bar{X}$
25.005 mm
centre line of the mean chart · mean of 11 subgroup means

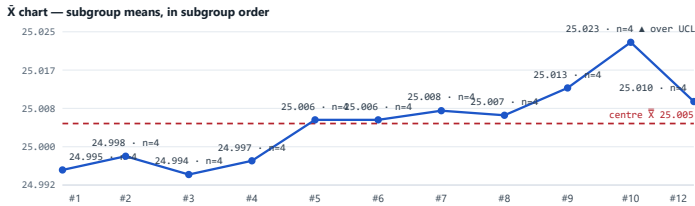
CONTROL LIMITS, MEAN CHART
24.993 to 25.018
 $\bar{X} \pm A_2\bar{R}$ · $A_2 = 0.729$ at $n = 4$ · $\bar{R} = 0.017$ mm

OUT-OF-CONTROL POINTS
1
worst: subgroup 10 mean 25.023 above the upper limit

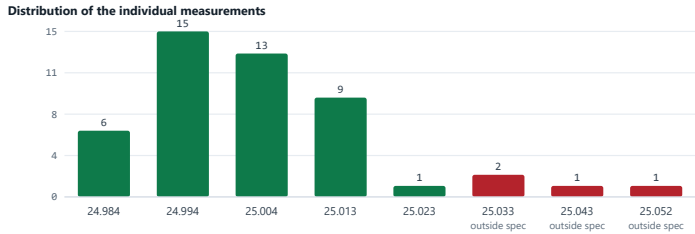
RUN-RULE SIGNALS
1
rule 2 — seven or more consecutive points on one side of the centre line, first at subgroup 12

ESTIMATED SIGMA
0.0084 mm
 $\bar{R} \div d_2$ · $d_2 = 2.059$ at subgroup size $n = 4$

12 of 12 record(s) included. All records. Amounts in USD.



Each point is the mean of one subgroup, drawn in subgroup order. Read this chart only after the R chart below is stable — if the spread is changing, these limits are built on a moving foundation. Points marked ▲ or ▼ sit beyond a control limit and are worth investigating; the limits themselves come from the whole register, so a filter changes what is drawn but not where the limits fall. Each point is the mean of one subgroup, drawn in subgroup order. Read this chart only after the R chart below is stable — if the spread is changing, these limits are built on a moving foundation. Points marked ▲ or ▼ sit beyond a control limit and are worth investigating; the limits themselves come from the whole register, so a filter changes what is drawn but not where the limits fall.



This is the raw spread of parts, which is what a customer receives; the mean chart smooths that spread by averaging. Bars are marked red where the bin falls outside a specification limit you have set. Specification limits are drawn here and nowhere else: they belong on a distribution, never on a control chart. This is the raw spread of parts, which is what a customer receives; the mean chart smooths that spread by averaging. Bars are marked red where the bin falls outside a specification limit you have set. Specification limits are drawn here and nowhere else: they belong on a distribution, never on a control chart.

Subgroup data

SUBGROUP	DATE	N	MEASUREMENTS	MEAN	RANGE	STATE	SIGNALS FIRED	SPECIAL CAUSE
1	2026-07-14	4	24.986 · 25.003 · 24.992 · 24.999	24.995	0.017	In control	—	
2	2026-07-15	4	25.007 · 24.989 · 25.000 · 24.996	24.998	0.018	In control	—	
3	2026-07-16	4	24.984 · 24.998 · 25.003 · 24.991	24.994	0.019	In control	—	
4	2026-07-17	4	25.008 · 24.988 · 24.996 · 24.996	24.997	0.020	In control	—	
5	2026-07-18	4	25.015 · 24.999 · 25.007 · 25.003	25.006	0.016	In control	—	
6	2026-07-21	4	24.997 · 25.013 · 25.005 · 25.009	25.006	0.016	In control	—	
7	2026-07-22	4	25.018 · 25.001 · 25.007 · 25.006	25.008	0.017	In control	—	
8	2026-07-23	4	25.002 · 25.016 · 24.999 · 25.011	25.007	0.017	In control	—	
9	2026-07-24	4	25.021 · 25.005 · 25.015 · 25.011	25.013	0.016	In control	—	
10	2026-07-25	4	25.033 · 25.016 · 25.026 · 25.017	25.023	0.017	OUT — above UCL	Rule 1 mean	
11	2026-07-28	4	25.048 · 25.021 · 25.062 · 25.033	25.041	0.041	Excluded	Coolant failure mid-run — pump replaced, parts quarantined	✓
12	2026-07-29	4	25.019 · 25.002 · 25.013 · 25.006	25.010	0.017	In control	Rule 2 run of seven	
Centre lines		4	from 11 subgroups used for the limits	25.005	0.017	$\bar{X}$ and $\bar{R}$	1 rule 1 · 1 rule 2	1

Control limits and capability context

FIGURE	VALUE	HOW IT IS WORKED OUT
Subgroups used for the limits	11	1 excluded as a known special cause
Subgroup size n	4	the size most of the subgroups share
$\bar{\bar{X}}$ process mean (centre line, mean chart)	25.005 mm	mean of the 11 subgroup means
R average range (centre line, R chart)	0.017 mm	mean of the 11 subgroup ranges
UCL, mean chart	25.018 mm	$\bar{\bar{X}} + A_2R \cdot A_2 = 0.729$
LCL, mean chart	24.993 mm	$\bar{\bar{X}} - A_2R \cdot A_2 = 0.729$
UCL, range chart	0.039 mm	$D_4R \cdot D_4 = 2.282$
LCL, range chart	0.000 mm	$D_3R \cdot D_3 = 0.000$ — zero for subgroups of five or fewer
Estimated process sigma	0.0084 mm	$R \div d_2 \cdot d_2 = 2.059$
Specification limits	24.970 to 25.030 mm	the customer's limits — not drawn on either control chart
Capability (Cp, Cpk)	not calculated here	capability compares the spread with the specification and belongs in the Process Capability tool, and only once these charts show a stable process

Subgroup register

CHARACTERISTIC	PROCESS	SUBGROUP	DATE	M1	M2	M3	M4	M5	UNIT	OPERATOR	SPECIAL CAUSE	CAUSE	SUBGROUP MEAN	SUBGROUP RANGE	N
Bore diameter, part 4471	CNC lathe 3	1	2026-07-14	24.986	25.003	24.992	24.999	0.000	mm	K. Bauer	No	—	24.995	0.017	4
Bore diameter, part 4471	CNC lathe 3	2	2026-07-15	25.007	24.989	25.000	24.996	0.000	mm	K. Bauer	No	—	24.998	0.018	4
Bore diameter, part 4471	CNC lathe 3	3	2026-07-16	24.984	24.998	25.003	24.991	0.000	mm	K. Bauer	No	—	24.994	0.019	4
Bore diameter, part 4471	CNC lathe 3	4	2026-07-17	25.008	24.988	24.996	24.996	0.000	mm	K. Bauer	No	—	24.997	0.020	4
Bore diameter, part 4471	CNC lathe 3	5	2026-07-18	25.015	24.999	25.007	25.003	0.000	mm	A. Ferreira	No	—	25.006	0.016	4
Bore diameter, part 4471	CNC lathe 3	6	2026-07-21	24.997	25.013	25.005	25.009	0.000	mm	A. Ferreira	No	—	25.006	0.016	4
Bore diameter, part 4471	CNC lathe 3	7	2026-07-22	25.018	25.001	25.007	25.006	0.000	mm	A. Ferreira	No	—	25.008	0.017	4
Bore diameter, part 4471	CNC lathe 3	8	2026-07-23	25.002	25.016	24.999	25.011	0.000	mm	A. Ferreira	No	—	25.007	0.017	4
Bore diameter, part 4471	CNC lathe 3	9	2026-07-24	25.021	25.005	25.015	25.011	0.000	mm	K. Bauer	No	—	25.013	0.016	4
Bore diameter, part 4471	CNC lathe 3	10	2026-07-25	25.033	25.016	25.026	25.017	0.000	mm	K. Bauer	No	—	25.023	0.017	4
Bore diameter, part 4471	CNC lathe 3	11	2026-07-28	25.048	25.021	25.062	25.033	0.000	mm	T. Andersson	Yes	Coolant failure mid-run — pump replaced, parts quarantined	25.041	0.041	4
Bore diameter, part 4471	CNC lathe 3	12	2026-07-29	25.019	25.002	25.013	25.006	0.000	mm	T. Andersson	No	—	25.010	0.017	4

Notes

Sample study — twelve subgroups of four, one of them excluded for a known coolant failure. Twelve subgroups is a start, not a settled set of limits: recalculate at twenty to twenty-five. Replace every reading with your own before relying on anything here.

Control limits calculated from a dozen subgroups are provisional. The usual guidance is 20 to 25 subgroups before limits are treated as settled, and until then every limit shown here should be read as a first estimate that will move as more data arrives. Recalculate when you have enough subgroups, when the process is deliberately changed, and after a special cause has been found and removed — never simply because a point went outside the limits. Widening limits until the points fit is not process control. The limits describe what this process does; they say nothing about what your customer will accept, and this tool does not calculate capability. Everything here is only as sound as the measurement system underneath it: if the gauge cannot resolve the variation, the chart is drawing the gauge.