Lecture #31

Karl Haapala

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Quality Engineering (MEEM 4650 / 5650)
Dept. of Mechanical Engineering - Engineering Mechanics
Michigan Technological University

X-bar & R Charts (Fig. 10.9)

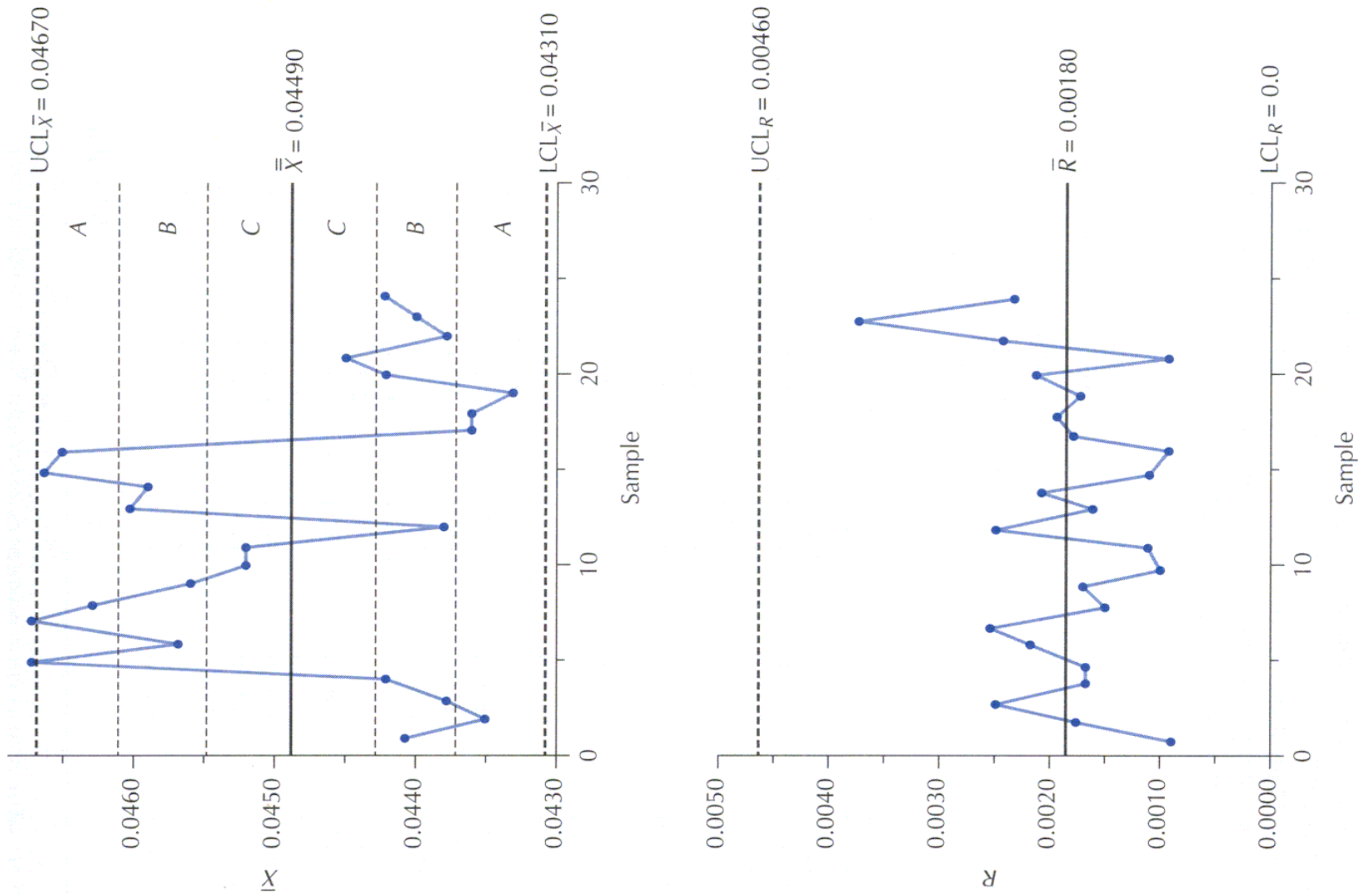


TABLE 10.3 Zone Violations from Fig. 10.10, $\bar{X}$ Chart

Subgroup	Rule(s) Violated
4	1. Four out of five in zone *B* or beyond
5	1. Extreme point
7	1. Extreme point
	2. Two out of three in zone *A* or beyond
8	1. Two out of three in zone *A* or beyond
	2. Four out of five in zone *B* or beyond
	3. Eight in a row outside zone *C*
9	1. Eight in a row outside zone *C*
	2. Four out of five in zone *B* or beyond.
16	1. Two out of three in zone *A* or beyond
	2. Four out of five in zone *B* or beyond
18	1. Two out of three in zone *A* or beyond
19	1. Two out of three in zone *A* or beyond
	2. Eight in a row outside zone *C*
20	1. Four out of five in zone *B* or beyond
	2. Eight in a row outside zone *C*
22	1. Four out of five in zone *B* or beyond
23	1. Four out of five in zone *B* or beyond
24	1. Four out of five in zone *B* or beyond
	2. Run of eight below the centerline

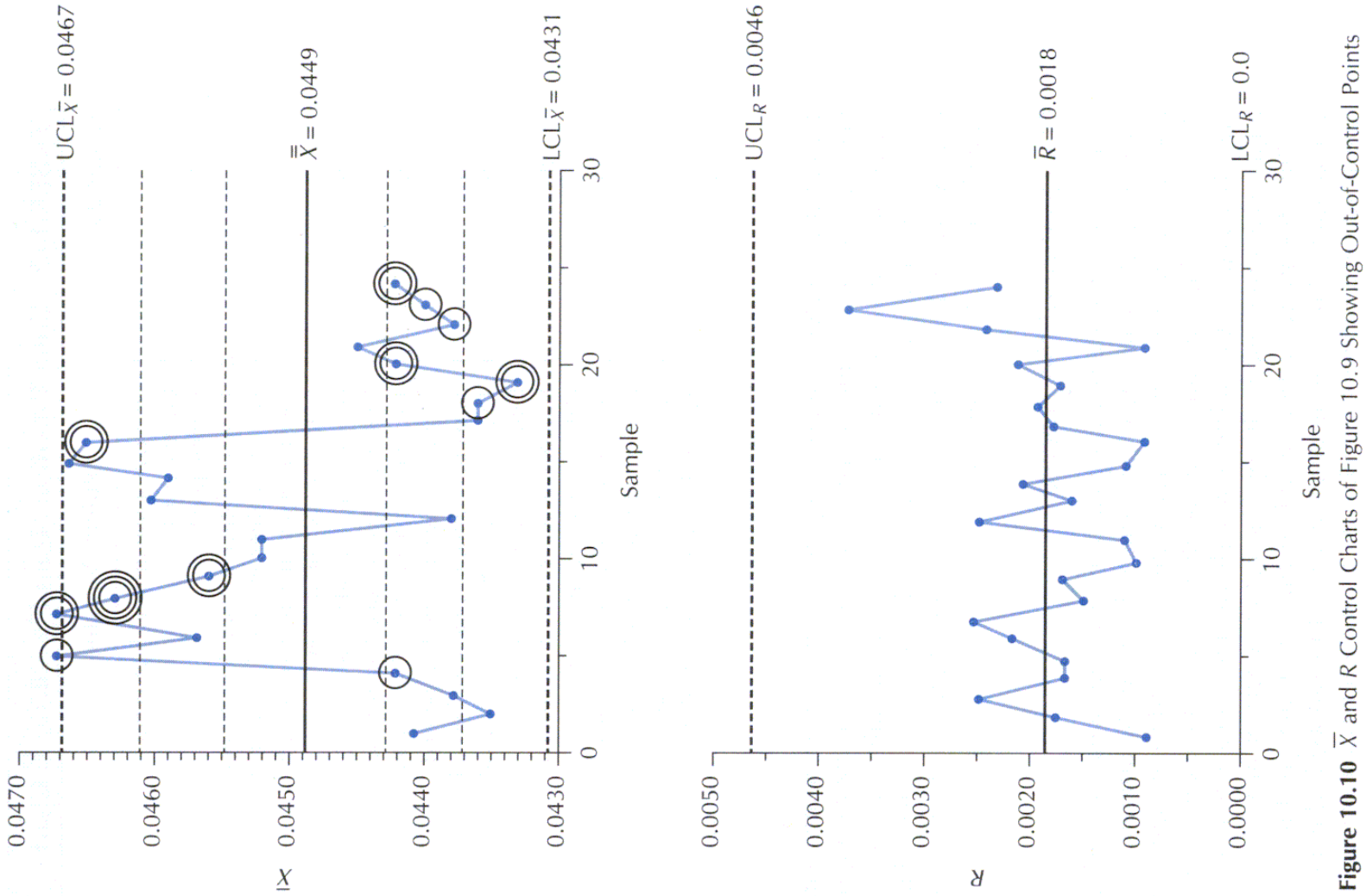


Figure 10.10 $\bar{X}$ and R Control Charts of Figure 10.9 Showing Out-of-Control Points

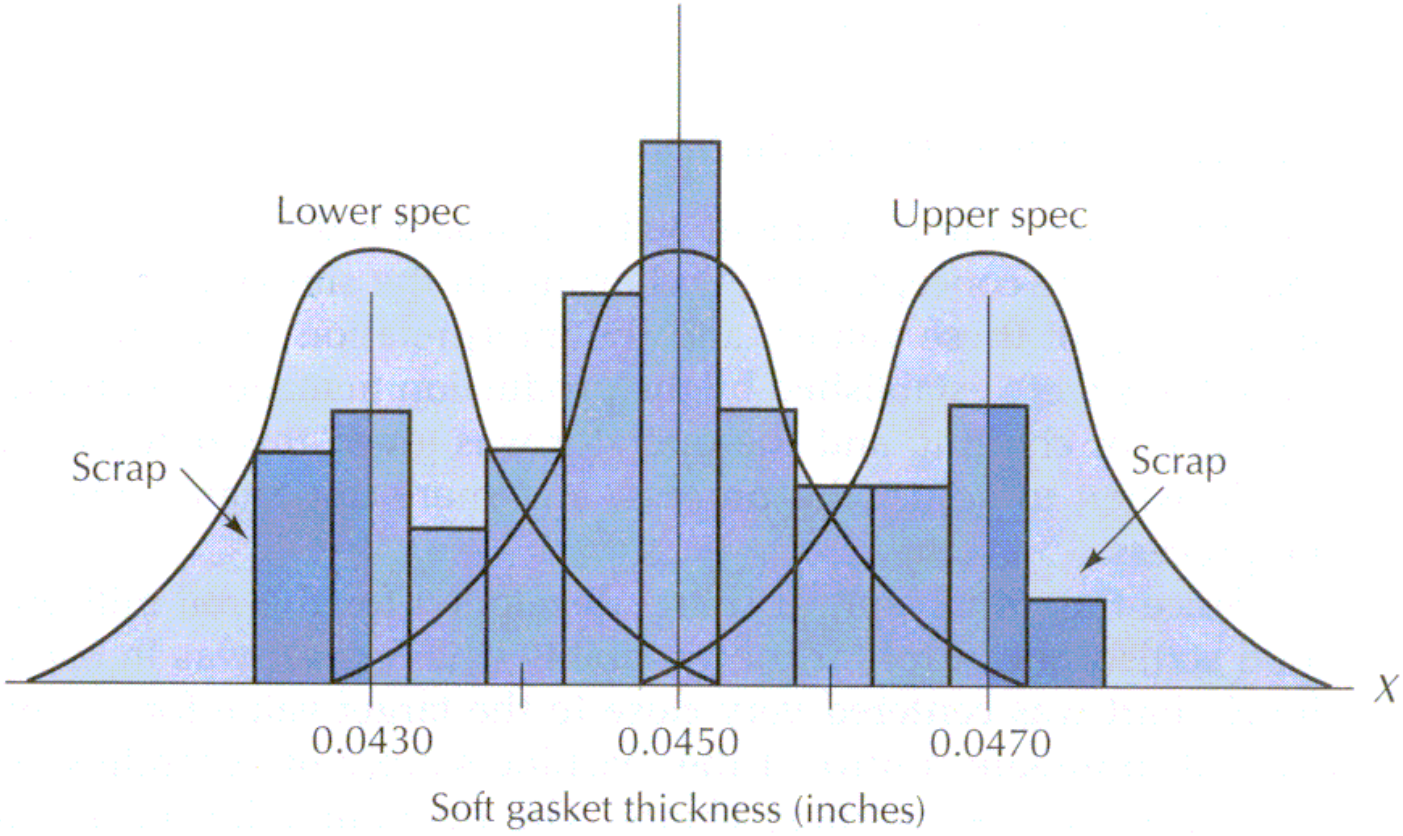


Figure 10.11 Consequences of Overcontrol on Process Performance

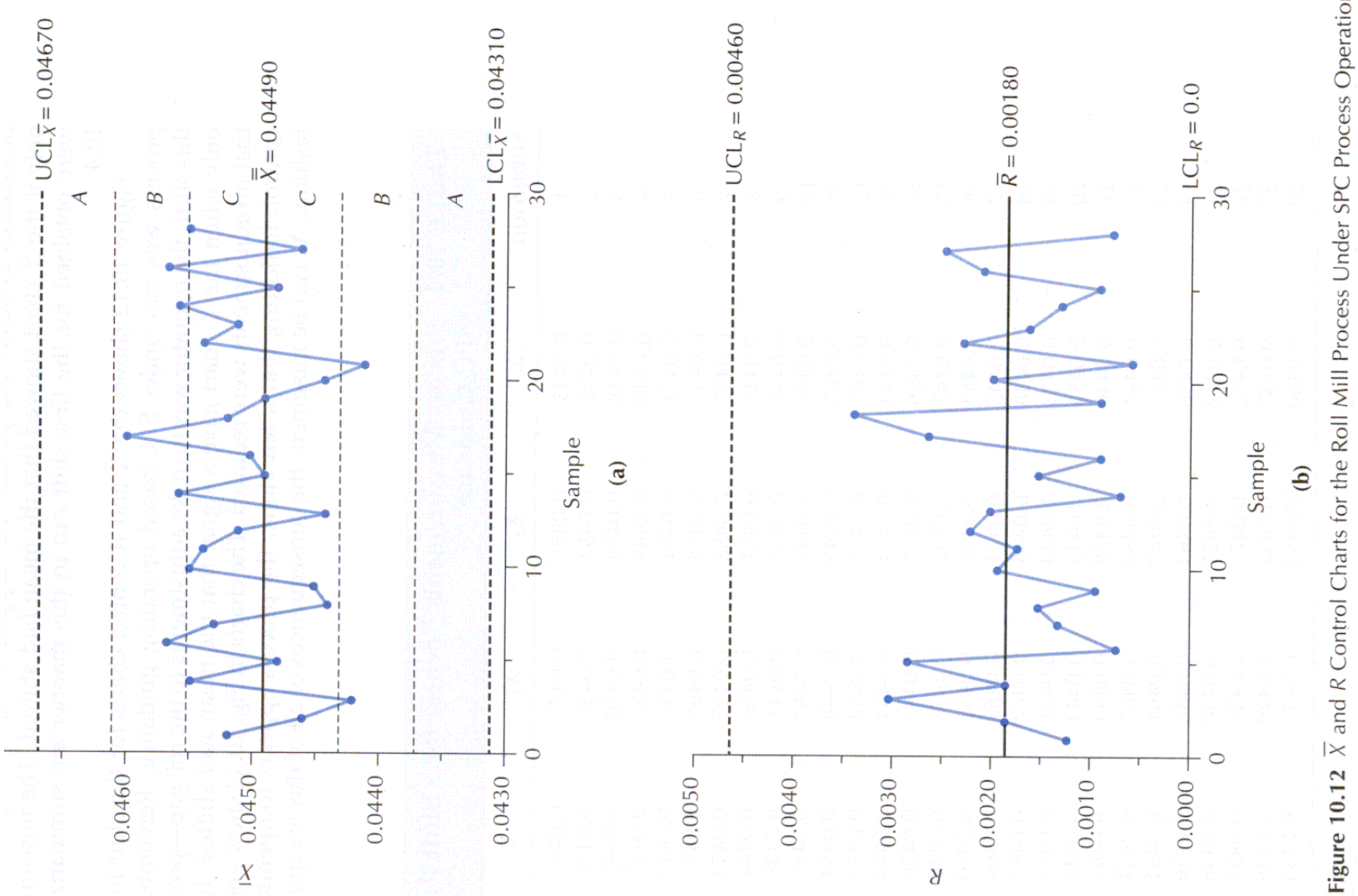


Figure 10.12 $\bar{X}$ and R Control Charts for the Roll Mill Process Under SPC Process Operation

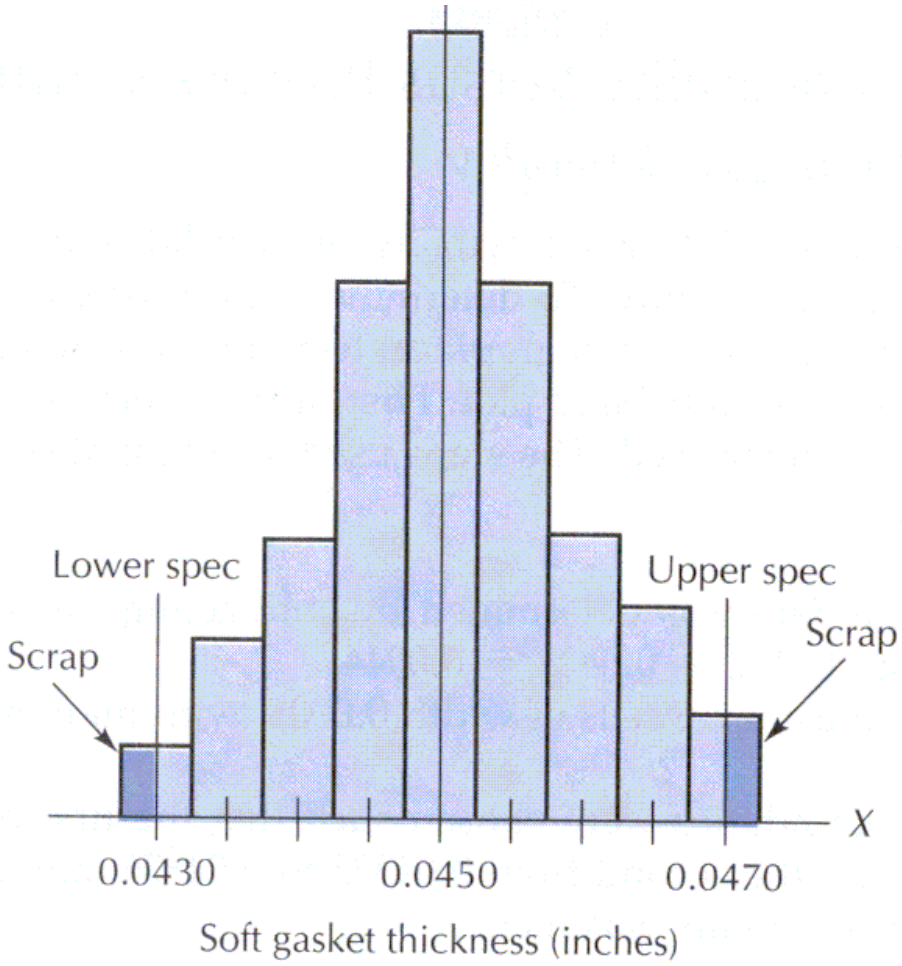


Figure 10.13 Histogram of the Gasket Measurements in Table 10.4

TABLE 10.5 Data for Normal Probability Plot of Fig. 10.14

Order	Measure-ment	Estimated Cumulative Probability (%)	Order	Measure-ment	Estimated Cumulative Probability (%)
1	0.0428	2	16	0.0450	52
2	0.0433	5	17	0.0451	55
3	0.0435	8	18	0.0451	58
4	0.0436	12	19	0.0453	62
5	0.0437	15	20	0.0454	65
6	0.0441	18	21	0.0455	68
7	0.0443	22	22	0.0455	72
8	0.0445	25	23	0.0455	75
9	0.0445	28	24	0.0457	78
10	0.0445	32	25	0.0458	82
11	0.0448	35	26	0.0459	85
12	0.0449	38	27	0.0461	88
13	0.0449	42	28	0.0461	92
14	0.0449	45	29	0.0467	95
15	0.0450	48	30	0.0468	98

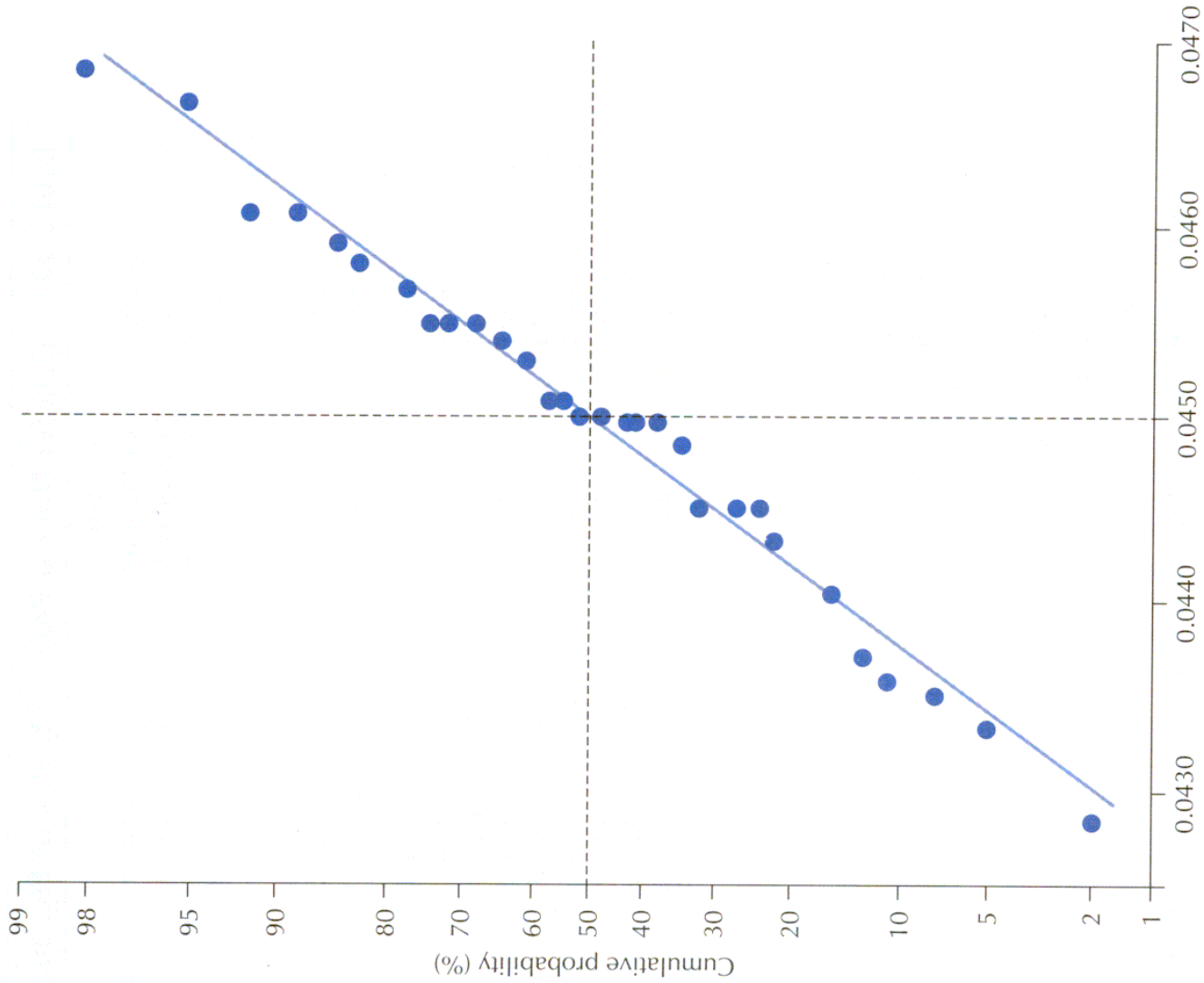


Figure 10.14 Normal Probability Plot Based on the Data of Table 10.5

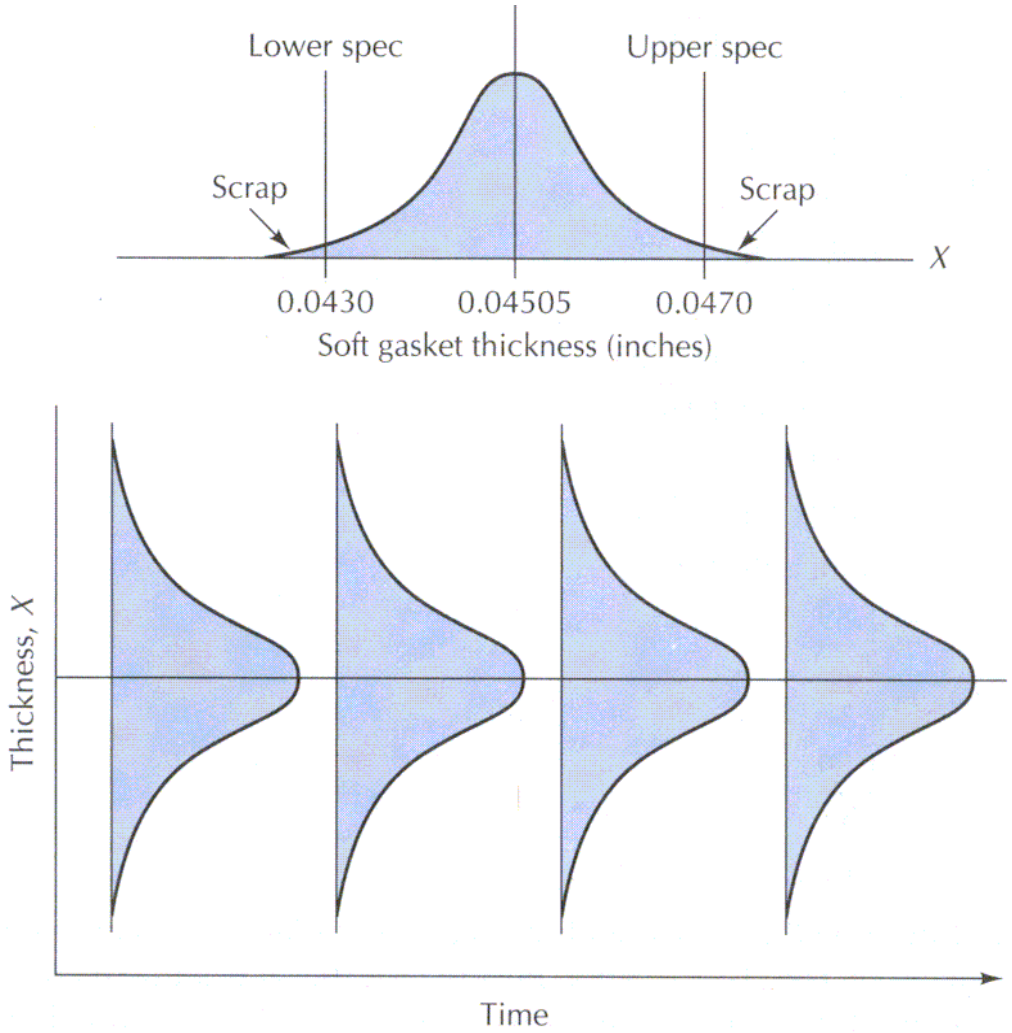


Figure 10.15 Process Capability Analysis Based on the Process Data of Table 10.4

84 sheets

Xdbar = 0.04505
Sig-x = 0.00103

Cap = 94.7%
C_p = 0.645
C_{pk} = 0.63

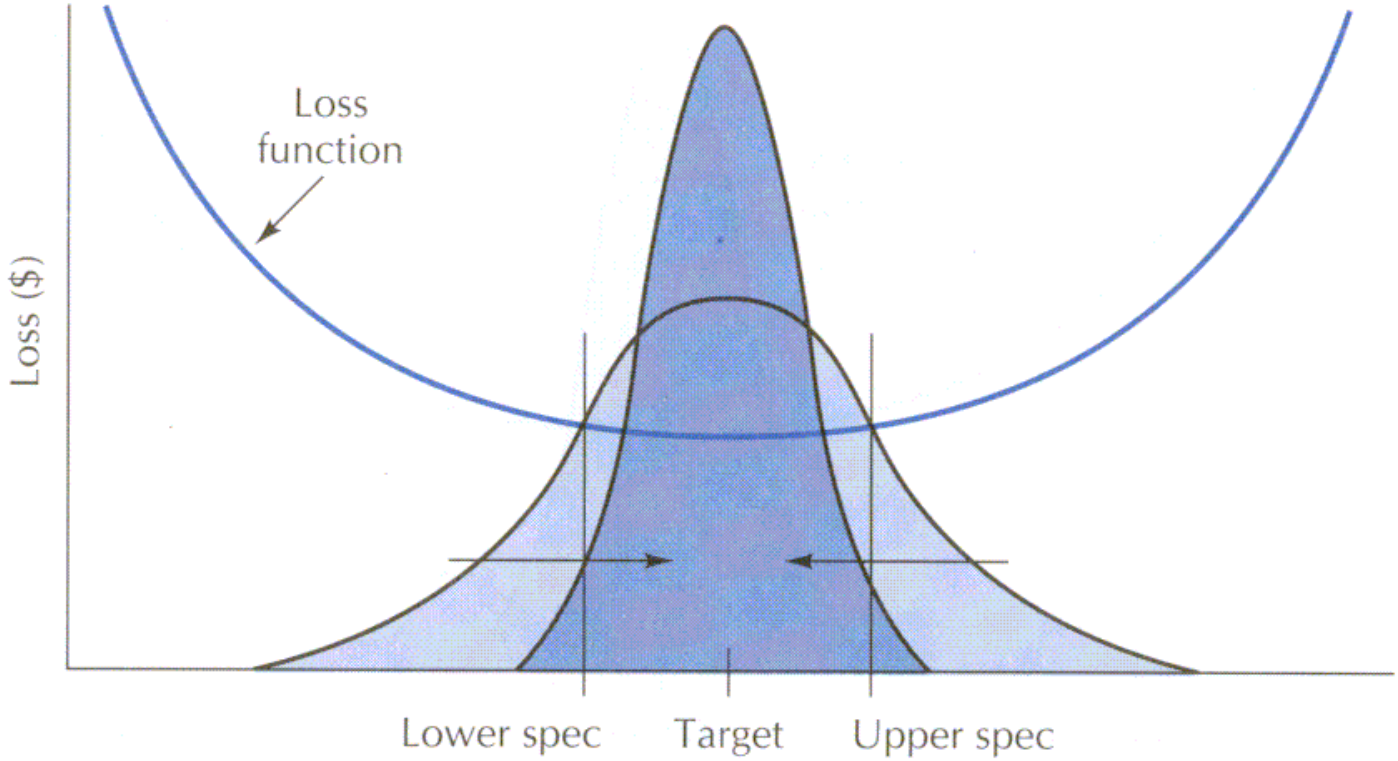


Figure 10.16 Loss Function View of Quality/Variability Relationship

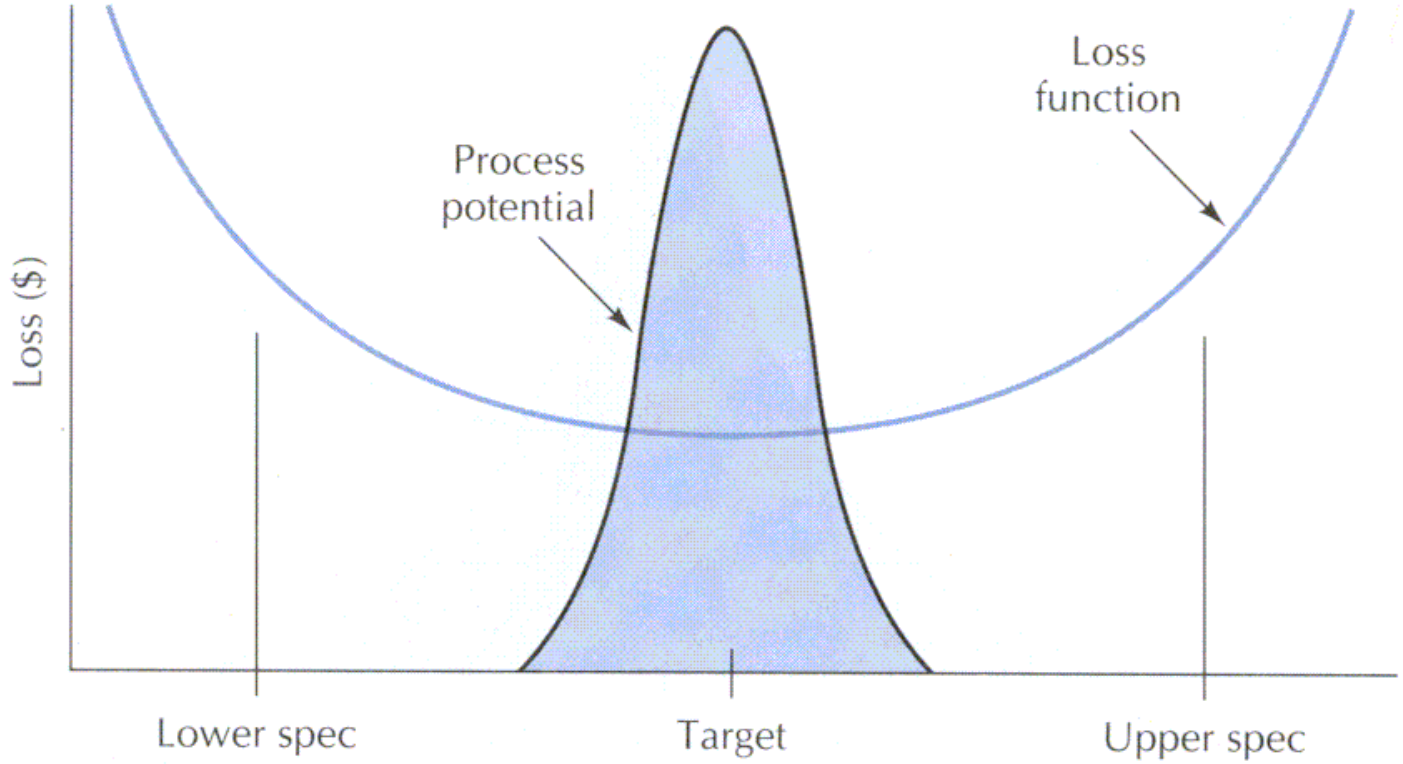


Figure 10.17 Loss If Process Is in a State of Statistical Control Centered at the Nominal

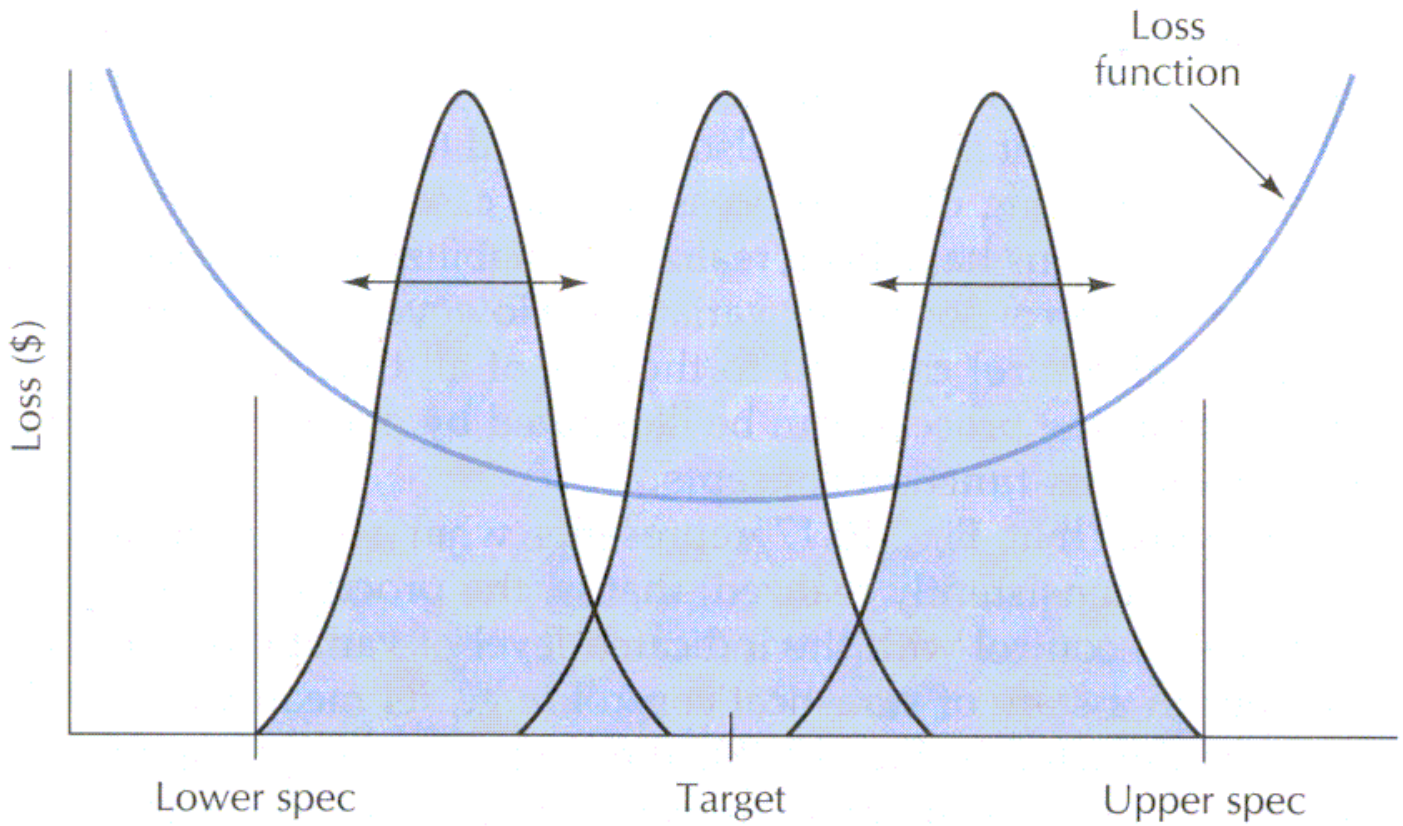


Figure 10.18 Behavior of Process If Statistical Control Is Not Maintained

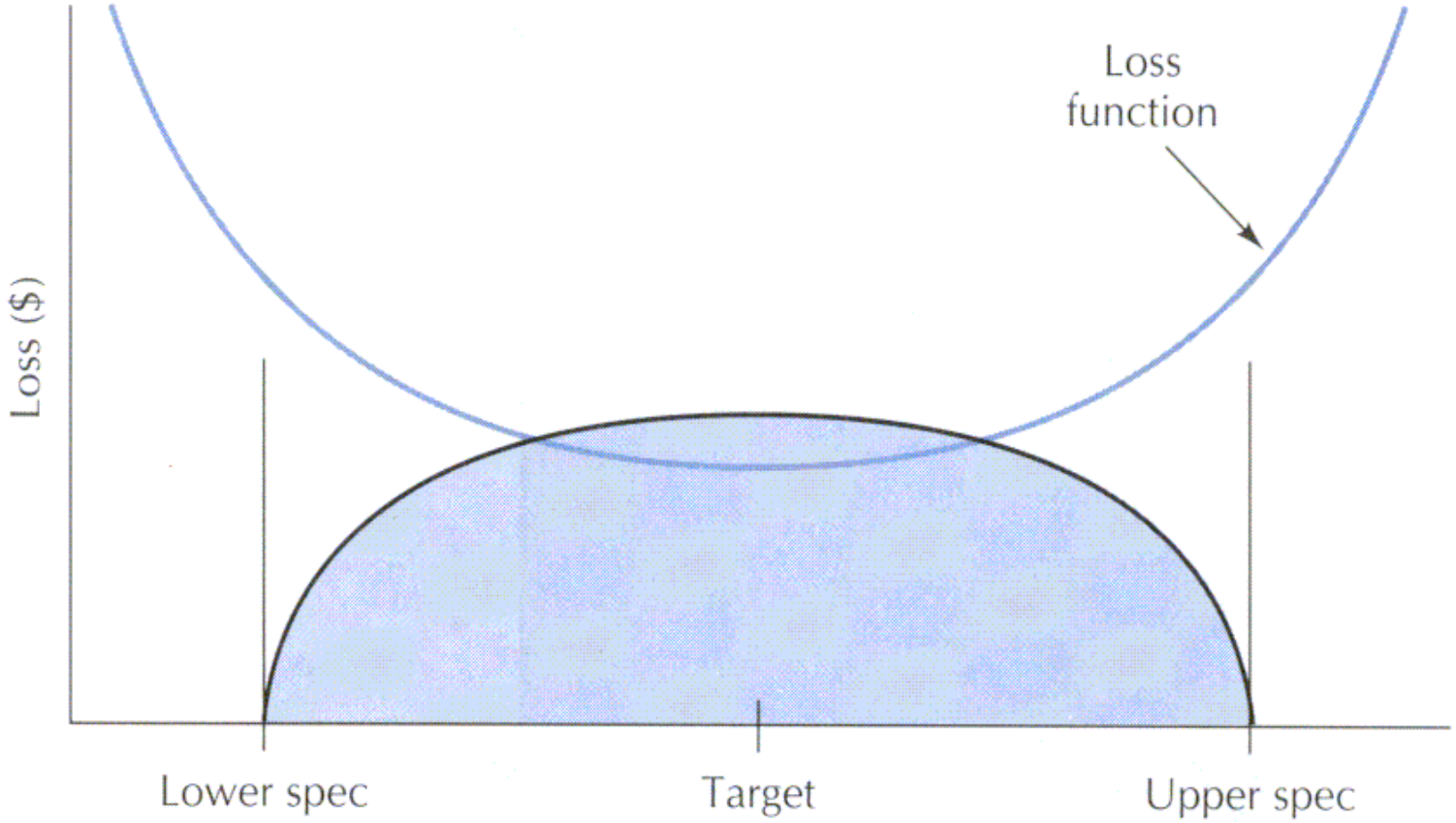


Figure 10.19 Loss If Statistical Control Is Not Maintained

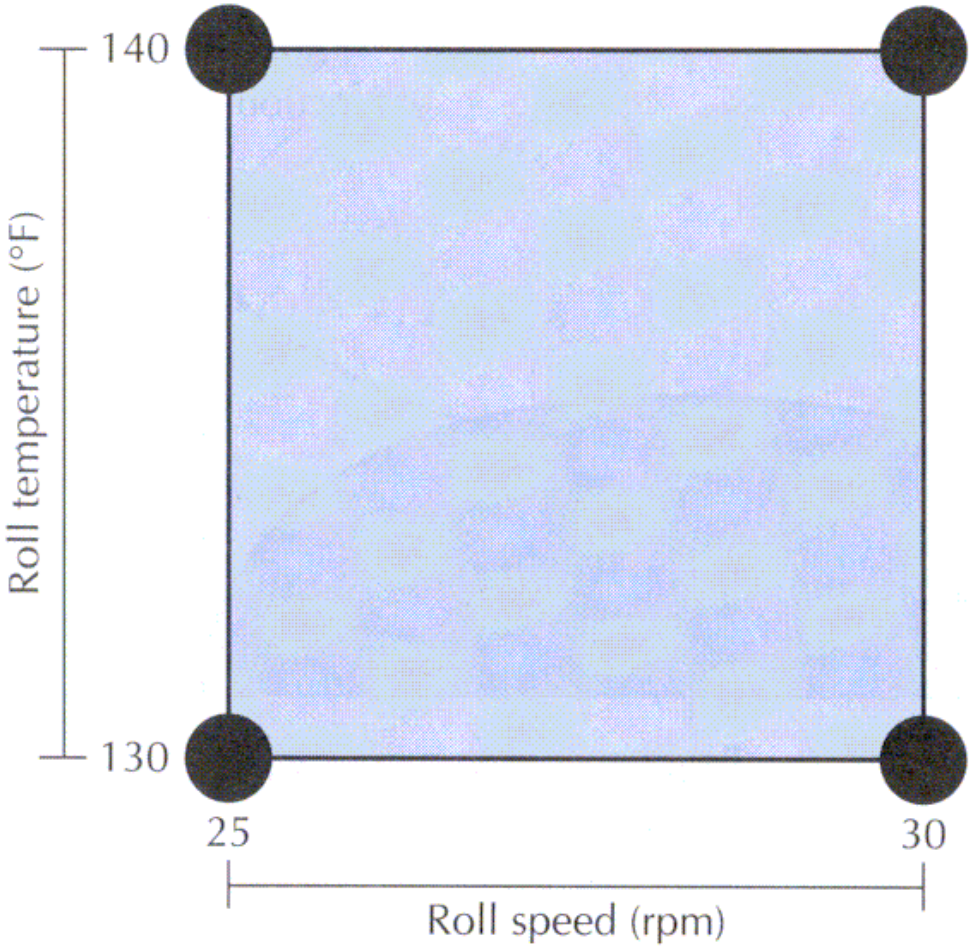


Figure 10.20 Two-Level Factorial Design to Study Roll Mill Process

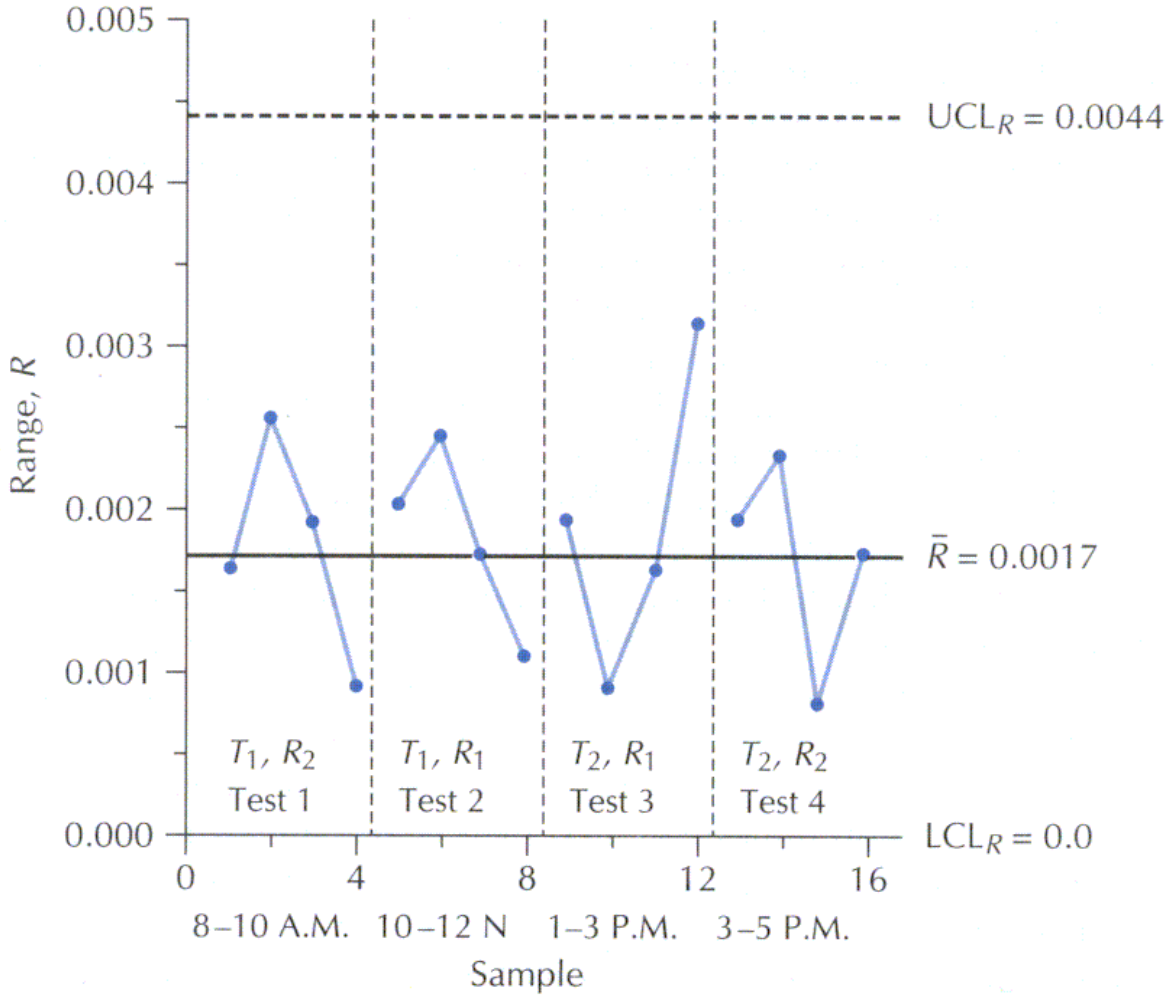


Figure 10.21 Range Chart for the Process over the Period of the Factorial Experiment

Taking Another Look at the Process

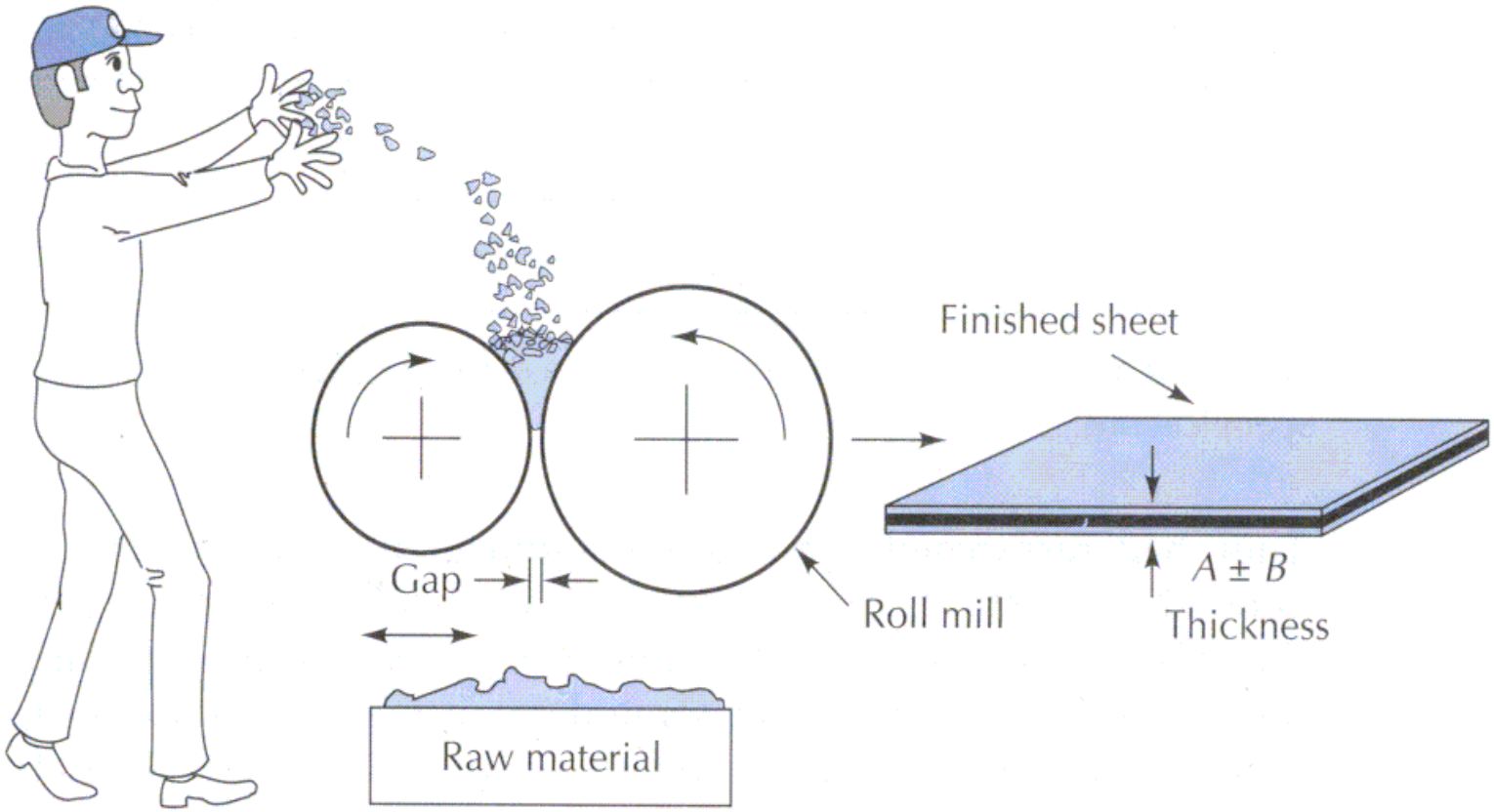
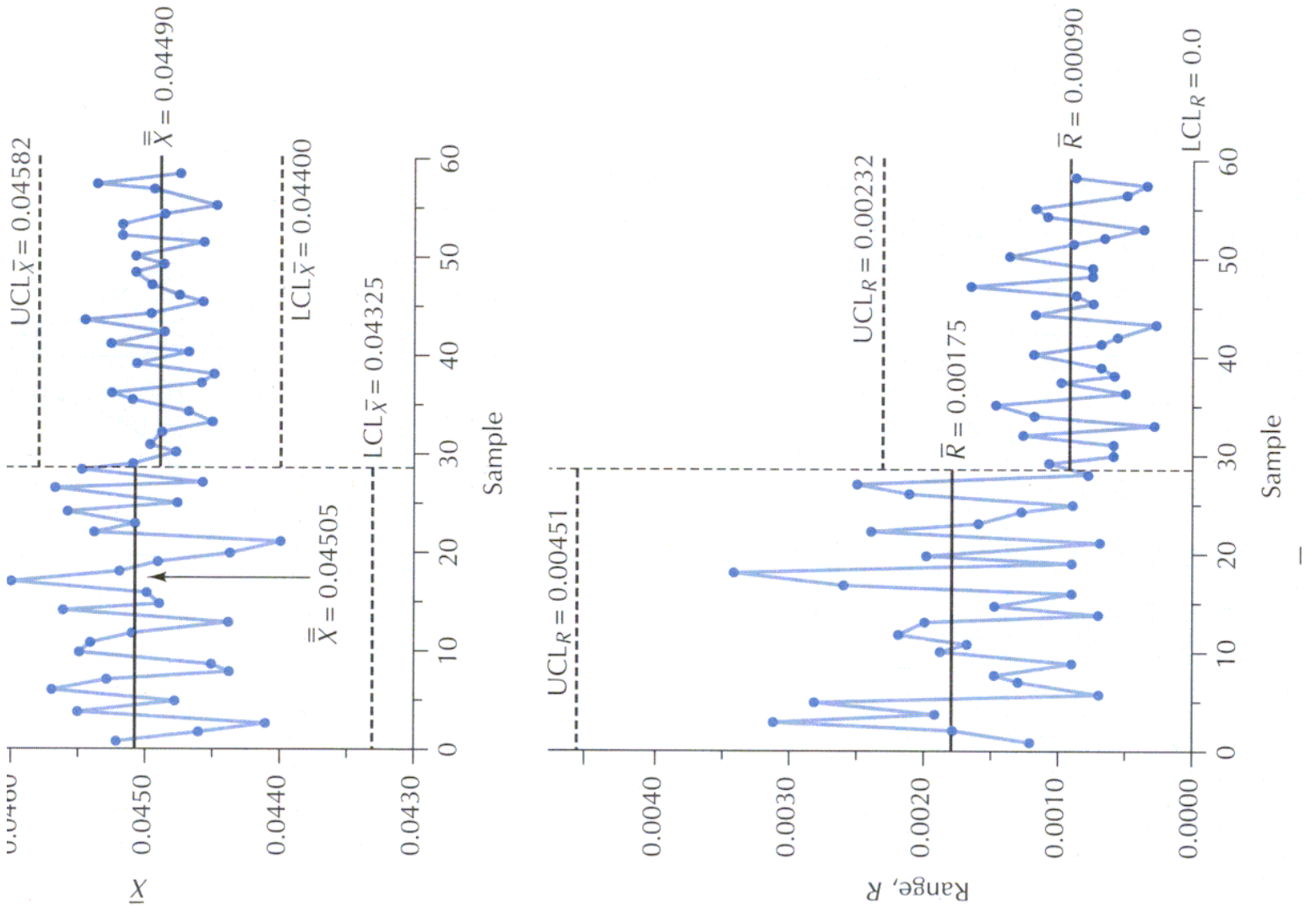


Figure 10.2 The Process: Roll Mill for the Manufacture of Soft Gasket Material

30 samples of size 3 (Fig. 10-22)



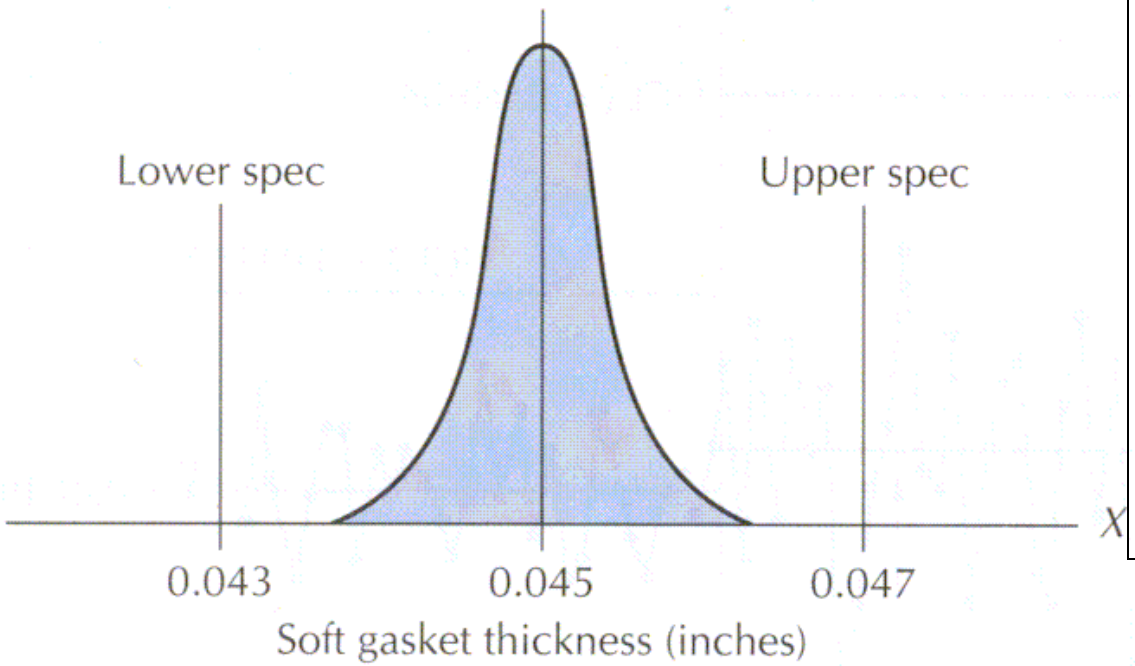


Figure 10.23 Process Capability After Material Metering Was Put into Effect

90 sheets

Xdbar = 0.04490
Sig-x = 0.00053

Cap > 99.9%
C_p = 1.253
C_{pk} = 1.19

Revisiting the Use of DOE

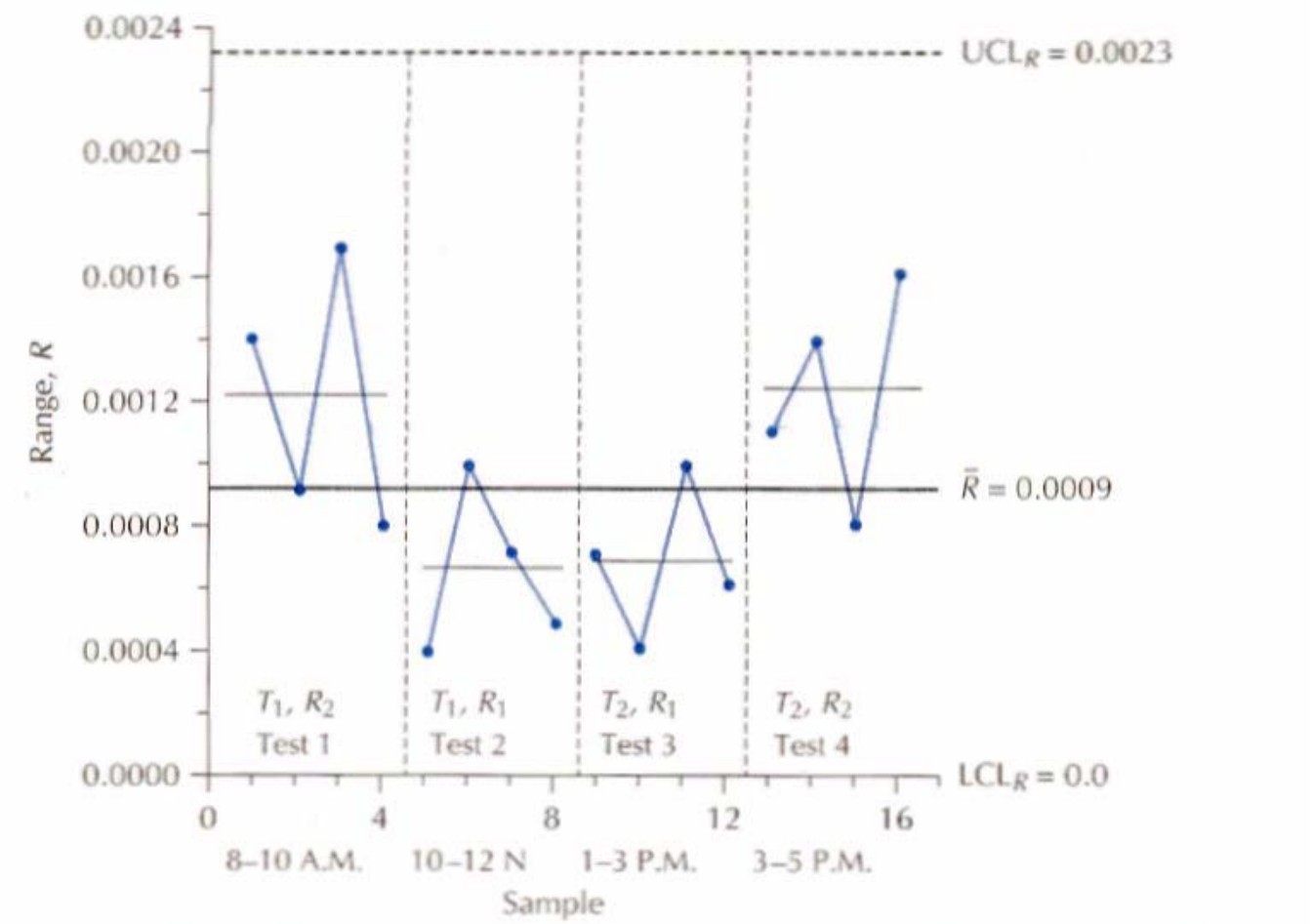
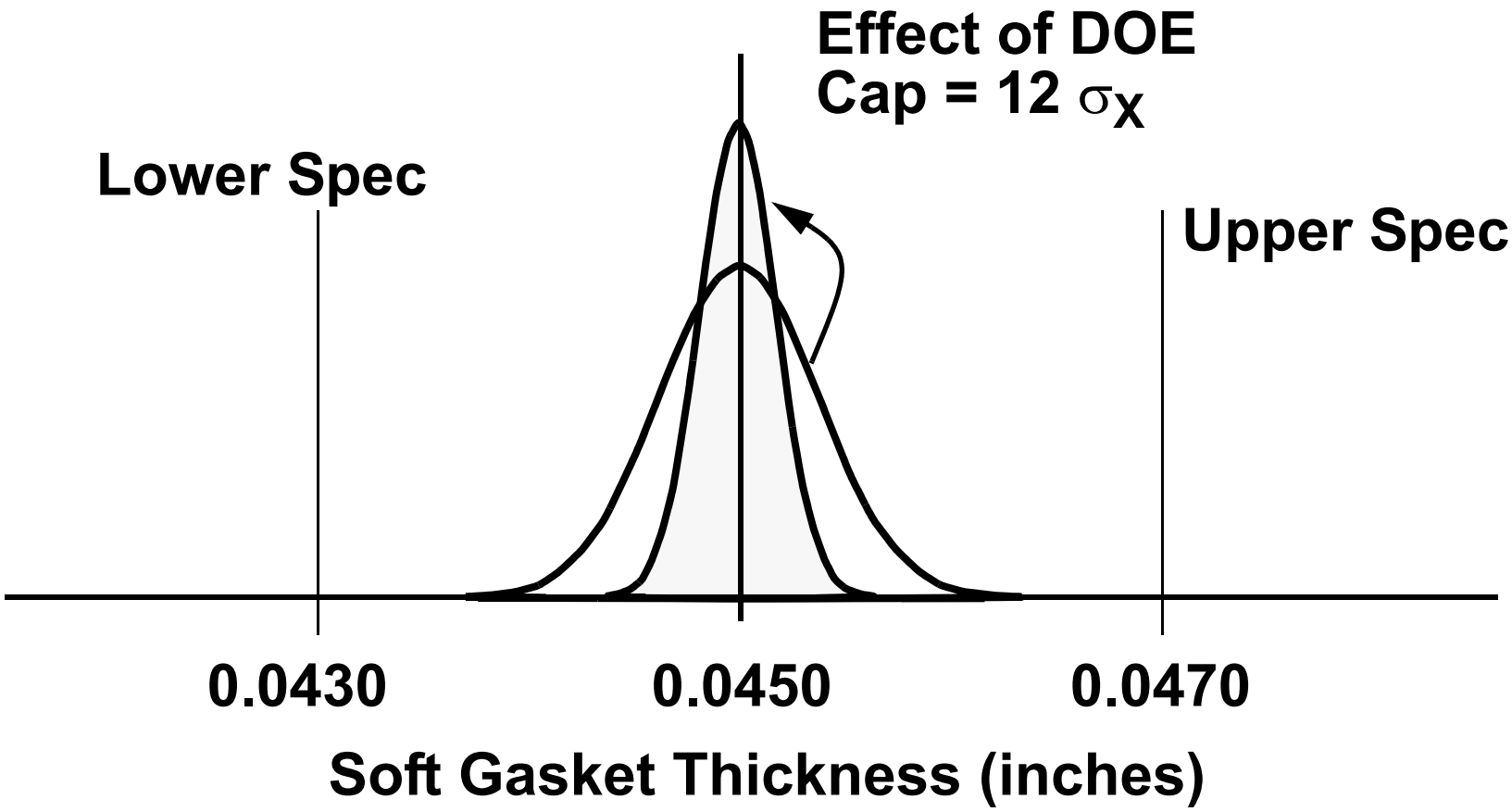


Figure 10.24 Results of the Repeated Factorial Experiment After Process Material Metering Was Initiated

Capability after DOE Study



A Postscript