



# AISI

## 品管報告

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# 量測資料

Measurement result



# 量測結果

產品數量：20個

檢驗人員：3人

單一產品量測數：3次/人



number	people	diameter	Length	Width	Left	Left-Center	Center	Right	Right-Center	Height
1	1	16.3	17.1	18.5	3.3	10	3.7	3.3	9.9	2.3
1	1	16.4	17	18.3	3.3	9.8	3.6	3.3	10.1	2.4
1	1	16.7	17.1	18.5	3.4	10	3.5	3.4	10	2.4
1	2	16.6	17	18.6	3.2	10.2	3.4	2.9	9.7	2.3
1	2	16.6	17.1	18.5	3.2	9.8	3.3	3.3	9.9	2.3
1	2	16.4	17.1	18.6	3.4	10.1	3.4	3.1	9.9	2.3
1	3	16.4	17	18.3	3.3	9.8	3.5	3.3	10	2.4
1	3	16.4	17	18.3	3.4	9.8	3.5	3.2	9.9	2.3
1	3	16.4	17.1	18.3	3.4	9.8	3.5	3.2	10	2.4
2	1	16.5	17.1	18.6	3.3	9.9	3.5	3.2	10	2.4
2	1	16.6	17.2	18.5	3.3	9.7	3.6	3.3	10.1	2.4
2	1	16.6	17.1	18.6	3.2	9.8	3.6	3.2	10	2.3
2	2	16.1	17	18.5	3.2	9.4	3.4	2.9	9.8	2.3
2	2	16.5	17	18.5	3.2	9.8	3.5	3.3	10.1	2.4
2	2	16.5	17.1	18.3	3.2	9.8	3.5	3.2	9.9	2.4
2	3	16.6	17.2	18.6	3.3	9.8	3.5	3.4	10	2.4
2	3	16.6	17.2	18.6	3.3	9.8	3.4	3.2	10.1	2.3
2	3	16.5	17.2	18.6	3.4	9.8	3.6	3.1	9.7	2.3
3	1	16.4	17	18.4	3.3	9.8	3.5	3.3	10	2.4
3	1	16.4	17	18.4	3.2	9.9	3.4	3.4	10	2.4
3	2	16.7	17.2	18.5	3.3	9.9	3.5	3.4	10	2.3
3	2	16.6	17	18.3	3.2	9.7	3.2	3.1	9.6	2.3
3	2	16.5	17.3	18.4	3.2	10.2	3.5	3.4	9.7	2.4
3	3	16.4	17.2	18.3	3.3	9.8	3.5	3.3	10	2.3
3	3	16.4	17.2	18.4	3.3	9.8	3.5	3.2	9.9	2.4
3	3	16.3	17	18.4	3.2	9.8	3.7	3.2	9.9	2.4
4	1	16.4	17.3	18.4	3.4	9.7	3.6	3.3	9.9	2.4
4	1	16.2	17.1	18.3	3.3	9.7	3.4	3.4	9.9	2.3

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Gauge R&R



# Gauge R&R模型

$$y_{ijk} = \mu + P_i + O_j + (PO)_{ij} + \varepsilon_{ijk} \quad \begin{cases} i = 1, 2, \dots, p \text{ (產品數量)} \\ j = 1, 2, \dots, o \text{ (檢驗人員數)} \\ k = 1, 2, \dots, n \text{ (量測次數)} \end{cases}$$

其中,

$$\begin{aligned} P_i &\sim N(0, \sigma_P^2) \\ O_j &\sim N(0, \sigma_O^2) \\ (PO)_{ij} &\sim N(0, \sigma_{PO}^2) \\ \varepsilon_{ijk} &\sim N(0, \sigma^2) \end{aligned}$$

# Variance Components

$$V(y_{ijk}) = \sigma_P^2 + \sigma_O^2 + \sigma_{PO}^2 + \sigma^2$$

使用  $\hat{\sigma}^2 = MS_E$

$$\hat{\sigma}_{PO}^2 = \frac{MS_{PO} - MS_E}{n}$$

$$\hat{\sigma}_O^2 = \frac{MS_O - MS_{PO}}{pn}$$

$$\hat{\sigma}_P^2 = \frac{MS_P - MS_{PO}}{on}$$

$$\hat{\sigma}_{reproducibility}^2 = \hat{\sigma}_O^2 + \hat{\sigma}_{PO}^2$$

$$\hat{\sigma}_{repeatability}^2 = \hat{\sigma}^2$$

※如果variance為負數，則直接令為0

	$\sigma_{reproducibility}^2$	$\sigma_{repeatability}^2$
diameter	0.0103	0.0130
length	0.0163	0.0067
width	0.0087	0.0063
left	0.0013	0.0074
left-center	0.0050	0.0119
center	0.0072	0.0103
right	0.0030	0.0129
right-center	0.0026	0.0146
height	0.0008	0.0059



# Variance of Gauge and Total

$$\hat{\sigma}_{Gauge}^2 = \hat{\sigma}_{reproducibility}^2 + \hat{\sigma}_{repeatability}^2$$

$$\sigma_{Total}^2 = \hat{\sigma}_P^2 + \hat{\sigma}_{Gauge}^2$$

	$\hat{\sigma}_{Gauge}^2$	$\sigma_{Total}^2$
diameter	0.0233	0.0238
length	0.0230	0.0230
width	0.0150	0.0159
left	0.0087	0.0100
left-center	0.0169	0.0193
center	0.0176	0.0183
right	0.0159	0.0166
right-center	0.0172	0.0190
height	0.0067	0.0068



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P/T Ratio

# P/T Ratio

產品的USL-LSL=0.5

$$P/T = \frac{k\hat{\sigma}_{Gauge}}{USL-LSL}$$

其中k=5.15或6

	<i>P/T</i> Ratio (k=5.15)	<i>P/T</i> Ratio (k=6)
diameter	1.5734	1.8330
length	1.5610	1.8187
width	1.2615	1.4697
left	0.9589	1.1171
left-center	1.3393	1.5603
center	1.3654	1.5908
right	1.2987	1.5130
right-center	1.3495	1.5723
height	0.8431	0.9823

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SNR



# SNR

$$SNR = \sqrt{\frac{2\rho_P}{1 - \rho_P}}$$

其中

$$\rho_P = \frac{\hat{\sigma}_P^2}{\hat{\sigma}_{Total}^2} = 1 - \rho_M$$
$$\rho_M = \frac{\hat{\sigma}_{Gauge}^2}{\hat{\sigma}_{Total}^2}$$

	$\rho_P$	$\rho_M$	SNR
diameter	0.0197	0.9803	0.2005
length	0.0000	1.0000	0.0000
width	0.0573	0.9427	0.3486
left	0.1297	0.8703	0.5459
left-center	0.1258	0.8742	0.5364
center	0.0399	0.9601	0.2882
right	0.0440	0.9560	0.3035
right-center	0.0970	0.9030	0.4634
height	0.0095	0.9905	0.1386

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DR

# DR

$$DR = \frac{1 + \rho_P}{1 - \rho_P}$$

	DR
diameter	1.0402
length	1.0000
width	1.1215
left	1.2980
left-center	1.2878
center	1.0832
right	1.0921
right-center	1.2147
height	1.0192





結論

Conclusion

# 結論

績效指標 {  
P/T ≤ 0.1  
SNR ≥ 5  
DR ≥ 4

猜測造成所有的指標皆不合標準的原因為本身量測資料誤差就極大，各個需量測的地方的平均全距偏大，所以導致此gauge並非capable

	P/T Ratio (k=5.15)	P/T Ratio (k=6)	SNR	DR
diameter	X	X	X	X
length	X	X	X	X
width	X	X	X	X
left	X	X	X	X
left-center	X	X	X	X
center	X	X	X	X
right	X	X	X	X
right-center	X	X	X	X
height	X	X	X	X



謝謝

Thanks for watching