测量系统分析MSA *GR&R--- 数据记录表 Data Worksheet*

报告编号Report NO. QC20-2020606

量具名称 Equipment Name	QC20	产品类型 Description	胶管内径	测量人员 Operator A	李明泽	测试日期 Test Tate	2022.06.06
量具编号 Equipment NO.	/	基件编号 P/N	/	测量人员 Operator B	彭延锋	平价人数 Appraisers	3
参数规格 Dimension	32.15±0.2	规格上限 USL	32.35	测量人员 Operator C	王波	试验次数 Trials	3
单位 Unit	MM	规格下限 LSL	31.95	过程变差/过程能力 Process Variation(σ/PP)	1	样 品 数 Samples	10

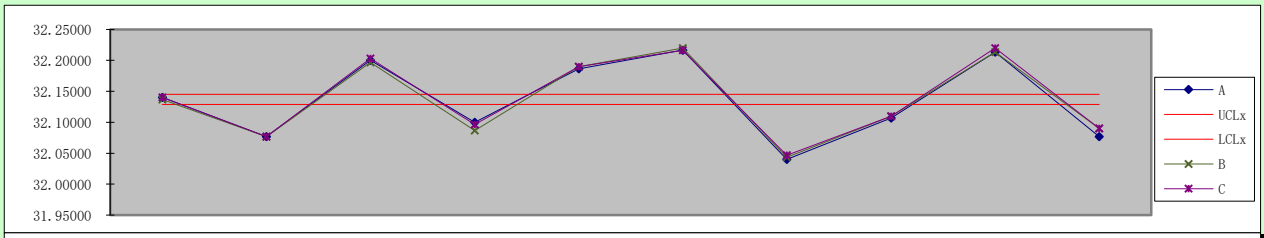
分析时机Analytical Occasion ◉ Regular ○ New QCP ○ PPAP ○ Other

零件编号Parts NO.	1	2	3	4	5	6	7	8	9	10	Total	平均值Average
1. A 1	32.14	32.08	32.2	32.1	32.19	32.22	32.04	32.11	32.22	32.08	321.38	32.138000
2. 2	32.14	32.07	32.2	32.11	32.19	32.21	32.04	32.11	32.2	32.08	321.35	32.135000
3. 3	32.14	32.08	32.2	32.09	32.18	32.22	32.04	32.1	32.22	32.07	321.34	32.134000
4. 均值Mean	32.14000	32.07667	32.20000	32.10000	32.18667	32.21667	32.04000	32.10667	32.21333	32.07667		$\overline{X}_A$ = 32.135667
Sum A	96.42	96.23	96.6	96.3	96.56	96.65	96.12	96.32	96.64	96.23	964.0700	
5. 极差Range	0	0.01	0	0.02	0.01	0.01	0	0.01	0.02	0.01		$\overline{R}_A$ = 0.009000
6. B 1	32.14	32.08	32.19	32.08	32.19	32.22	32.04	32.11	32.22	32.09	321.36	32.136000
7. 2	32.14	32.07	32.2	32.08	32.19	32.22	32.05	32.11	32.21	32.09	321.36	32.136000
8. 3	32.13	32.08	32.2	32.1	32.19	32.22	32.04	32.11	32.21	32.09	321.37	32.137000
9. 均值Mean	32.13667	32.07667	32.19667	32.08667	32.19000	32.22000	32.04333	32.11000	32.21333	32.09000		$\overline{X}_B$ = 32.136333
Sum B	96.41	96.23	96.59	96.26	96.57	96.66	96.13	96.33	96.64	96.27	964.0900	
10. 极差Range	0.01	0.01	0.01	0.02	0	0	0.01	0	0.01	0		$\overline{R}_B$ = 0.007000
11. C 1	32.14	32.08	32.21	32.1	32.19	32.22	32.04	32.11	32.23	32.09	321.41	32.141000
12. 2	32.14	32.08	32.2	32.09	32.19	32.21	32.04	32.11	32.21	32.09	321.36	32.136000
13. 3	32.14	32.07	32.2	32.1	32.19	32.22	32.06	32.11	32.22	32.09	321.4	32.140000
14. 均值Mean	32.14000	32.07667	32.20333	32.09667	32.19000	32.21667	32.04667	32.11000	32.22000	32.09000		$\overline{X}_C$ = 32.139000
Sum C	96.42	96.23	96.61	96.29	96.57	96.65	96.14	96.33	96.66	96.27	964.17	
15. 极差Range	0.0000	0.0100	0.0100	0.0100	0.0000	0.0100	0.0200	0.0000	0.0200	0.0000		$\overline{R}_C$ = 0.008000
零件均值 Parts Mean $\overline{X}_P$	32.138889	32.076667	32.200000	32.094444	32.188889	32.217778	32.043333	32.108889	32.215556	32.085556		$\overline{\overline{X}}$ = 32.137000
Total	289.250000	288.690000	289.800000	288.850000	289.700000	289.960000	288.390000	288.980000	289.940000	288.770000	2892.33	R_P = 0.174444

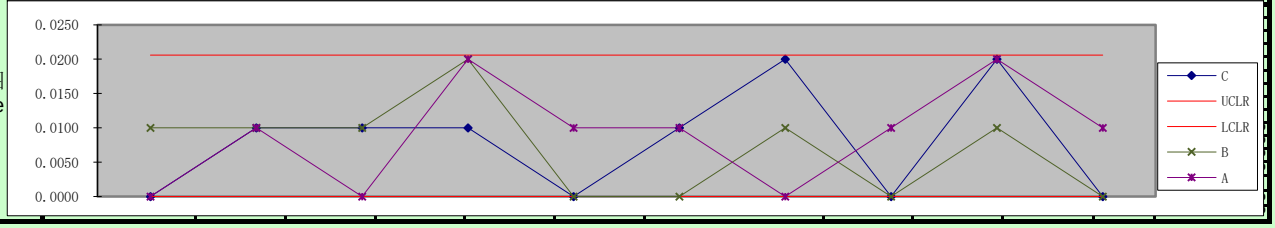
$\overline{\overline{R}} = (\overline{R_A} + \overline{R_b} + \overline{Rc}) / Appraisers$ =	0.008000	试验次数Trials		2	3
$X_{DIFF} = Max\overline{X} - Min\overline{X}$ =	0.003333		D4	3.27	2.575
$UCL_{\bar{x}} = \overline{\overline{X}} + A_2\overline{R}$ =	32.145184	$UCL_R = D_4\overline{R}$ =	0.020600	D3	0	0
$LCL_{\bar{x}} = \overline{\overline{X}} - A_2\overline{R}$ =	32.128816	$LCL_R = D_3\overline{R}$ =	0.000000	A2	1.88	1.023

注:当分析结果超出要求后，利用均值极差图分析原因When analysis result is out of spec,need analyse the root cause by mean and range chart 。

均值图 mean chart



极差图 Range chart



测量系统分析MSA GR&R---均值极差法Average and method

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量具名称 Equipment	QC20	产品类型 Description	胶管内径	测量人员 Operator A	李明泽	测试日期 Test	2022.06.06
量具编号 Equipment NO.	/	基件编号 Part NO.	/	测量人员 Operator B	彭延锋	评价人数 Appra	3
参数规格 Specification	32.15±0.2	规格上限 Upper limit	32.35	测量人员 Operator C	王波	试验次数 Trials	3
测量单位 Unit	MM	规格下限 Lower Limit	31.95	过程变差/过程能力 Process Variation(σ/PP)	1	样 品 数	10

Datasheet: $\bar{\bar{R}}$ = 0.008000 $\overline{X}_{DIFF}$ = 0.003333 R_p = 0.174444

分析方式Analysis mode ***基于过程能力Base on process PP***

测量系统分析MSA	% 总变差Total variation（TV）
重复性Repeatability－设备变差Equipment Variation(EV) $EV = \bar{\bar{R}} * K_1$ = 0.004726	$\%EV = 100 * (EV/TV)$ = 7.09%
再现性Reproducibility－評价人变差Appraiser Variation(AV) $AV = \sqrt{(\bar{X}_{DIFF} * K_2)^2 - (EV^2/nr)}$ = 0.001515	$\%AV = 100 * (AV/TV)$ = 2.27%
重复性和再现性Repeatability and Reproducibility(R&R) $R\&R = \sqrt{EV^2 + AV^2}$ = 0.004963	$\%R\&R = 100 * (R\&R/TV)$ = 7.44%
零件变差Parts Variation(PV) $PV = R_p \times K_3$ = 0.054880 公式A Formula A A $PV = R_p \times K_3$ B $PV = \sqrt{TV^2 - GRR}$	$\%PV = 100 * (PV/TV)$ = 82.32%
总变差Total Variation(TV) $TV = \sqrt{R\&R^2 + PV^2}$ 基于零件变差Base on parts variation $TV = \sigma$ 基于过程变差Base on process variation $TV = Tol/6$ 基于零件公差Base on parts spec $TV = (USL - LSL)/6PP$ 基于过程能力Base on process PP = 0.066667	有效分辨率Availability Resolution(NDC)=1.41*（PV/R&R） = 16

零件数量 Part	K_3
3	0.5231
4	0.4467
5	0.4043
6	0.3742
7	0.3534
8	0.3375
9	0.3249
10	0.3146

试验次数 Trials	K_1
2	0.8862
3	0.5908

评价人数 Appraise	K2
2	0.7071
3	0.5231

判定标准Decide Criterion

1) 0%<%R&R<10%：量测系统状况良好Excellent；

10%≤%R&R≤30%：量测系统状况可以接收，但需改进Accepted but need improvement；

30%<%R&R<100%：量测系统必须改进Rejected and must be improved 。

2) 数据分级数NDC经四舍五入取整后，必须大于或等于5 The NDC is truncated to the integer and ought to be greater than or equal to 5。

判定Decide ***良好Excellent***

分析评价措施 Analysis and action	
分析人Analyst	熊丽萍
日期Date	2022.06.06

测量系统分析MSA GR&R---变差数分析法ANOVA method

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量具名称 Equipment	QC20	产品类型 Description	胶管内径	测量人员 Operator A	李明泽	测试日期	2022.06.06
量具编号 Equipment NO.	/	基件编号 Part NO.	/	测量人员 Operator B	彭延锋	平价人数	3
参数规格 Specification	32.15±0.2	规格上限 Upper limit	32.35	测量人员 Operator C	王波	试验次数	3
测量单位 Unit	MM	规格下限 Lower Limit	31.95	过程变差 Process Variation(6σ)	1	样 品 数	10

方差分析表格 ANOVA Table 不包含without 操作员和零件的相互作用 Operator*Part Interaction

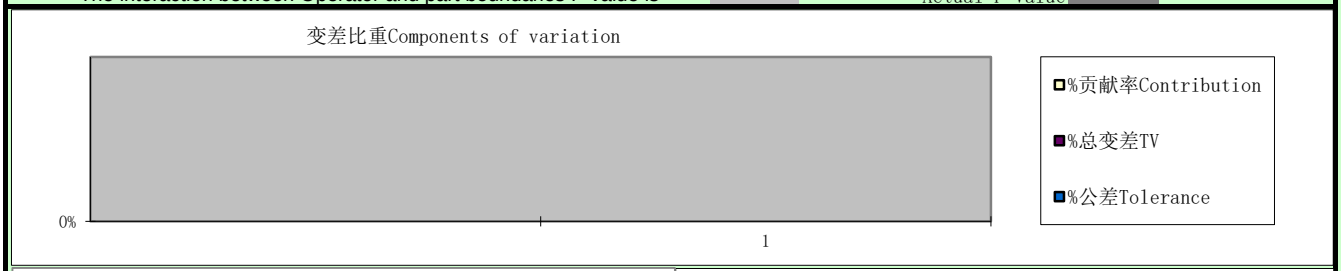
变差来源 Source	自由DF Degree of freedom	平方的总和SS Sum of squares	平均平方MS Mean square	F-比率 F-ratio	有效分辨率Availability Resolution(NDC)
零件Parts	9	0.3332	0.0370	995.0110	
评价者Operators	2	0.0002	0.0001	2.5084	
评价者和零件Operators*Part	0	0.0000	0.0000	0.0000	
设备Equipment	78	0.0029	0.0000		14.45908 ≈14
汇总Total	89	0.3363			

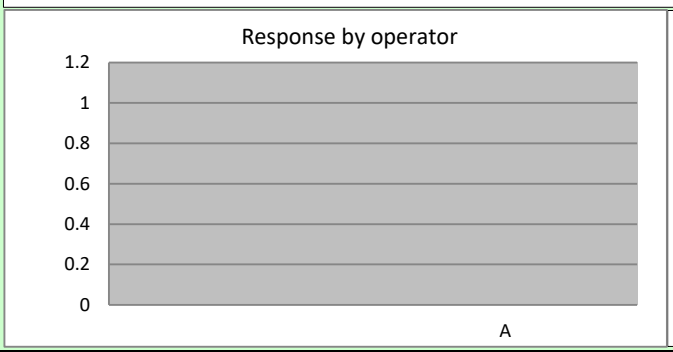
变差来源 Source	变差估计值 Estimate of vaiance	标准偏差 Stdev	%贡献率Contribution	%总变差TV	%公差Tolerance
系统Total Gauge R&R	0.0000	0.0063	**0.94%**	**9.71%**	**9.38%**
重复性Repeatability	0.0000	0.0061	0.90%	9.47%	9.15%
再现性Reproducibility	0.0000	0.0014	0.05%	2.12%	2.05%
评价者Operator	0.0000	0.0014	0.05%	2.12%	2.05%
相互作用InteractionINT=0	0	0	0	0	0
零件Part	0.0041	0.0641	99.06%	99.53%	96.16%
总变差Total Variation	0.0041	0.0644	100.00%	100.00%	96.61%

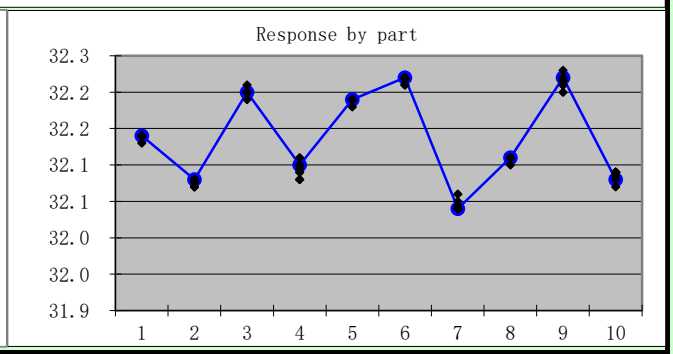
Note: Refer to above tables because P value of operator*Part is greater than setting value

人与零件相互作用分界 P值 The interaction between Operator and part boundaries P value is **0.25**

实际P值 Actual P Value 0.289







分析方法 Analysis method	*基于零件变差Base on parts variation*	*结论 Result*	*良好Excellent*
分析评价措施 Analysis and action			
分析人Analyst	熊丽萍	日期Date	2022.06.06