GAUGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET
VARIABLE DATA RESULTS

Part Number	23421-K0NA-D000	Gauge Name	OBD MICROMETER	Appraiser A	PRAKASH
Part Name	C1 K0NA	Gauge Number	C07L01BR0011-005	Appraiser B	ISMILE
Characteristic OBD	Specification 72.860 - 72.890	Gauge Type	VARIABLE	Appraiser C	PRASANNA
Characteristic Classification	CRITICAL	Trials 3	Parts 10	Appraisers 3	Date Performed 25/06/2019

APPRAISER/ TRIAL #		PART 1	2	3	4	5	6	7	8	9	10		AVERAGE
1. A	1	72.862	72.863	72.865	72.869	72.872	72.882	72.884	72.878	72.881	72.888		72.874
2.	2	72.862	72.862	72.865	72.869	72.873	72.883	72.883	72.879	72.882	72.887		72.875
3.	3	72.861	72.863	72.866	72.871	72.874	72.882	72.883	72.879	72.881	72.889		72.875
4.	AVE	72.862	72.863	72.865	72.870	72.873	72.882	72.883	72.879	72.881	72.888	X_a=	72.875
5.	R	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001	0.002	r_a=	0.001
6. B	1	72.864	72.863	72.865	72.869	72.873	72.881	72.884	72.878	72.881	72.888		72.875
7.	2	72.863	72.861	72.865	72.869	72.872	72.883	72.883	72.878	72.882	72.889		72.875
8.	3	72.861	72.863	72.865	72.871	72.874	72.882	72.883	72.879	72.881	72.888		72.875
9.	AVE	72.863	72.862	72.865	72.870	72.873	72.882	72.883	72.878	72.881	72.888	X_b=	72.875
10.	R	0.003	0.002	0.000	0.002	0.002	0.002	0.001	0.001	0.001	0.001	r_b=	0.001
11. C	1	72.863	72.863	72.865	72.869	72.873	72.881	72.884	72.878	72.881	72.888		72.875
12.	2	72.862	72.861	72.865	72.869	72.872	72.883	72.883	72.880	72.882	72.887		72.874
13.	3	72.861	72.863	72.865	72.871	72.874	72.882	72.883	72.879	72.881	72.889		72.875
14.	AVE	72.862	72.862	72.865	72.870	72.873	72.882	72.883	72.879	72.881	72.888	X_c=	72.875
15.	R	0.002	0.002	0.000	0.002	0.002	0.002	0.001	0.002	0.001	0.002	r_c=	0.002
16. PART AVE (Xp)		72.862	72.862	72.865	72.870	72.873	72.882	72.883	72.879	72.881	72.888	X= R_p=	72.875 0.026
17.	$(r_a + r_b + r_c)$ / (# OF APPRAISERS) =											R=	0.0015
18.	(Max X - Min X) =											X_{DIFF}=	0.0000
19.	R x D_4* =											UCL_R=	0.0038
20.	R x D_3* =											LCL_R=	0.0000
Reference Values		72.862	72.862	72.865	72.870	72.873	72.882	72.883	72.879	72.881	72.888		

* D_4 =3.27 for 2 trials and 2.58 for 3 trials; D_3 = 0 for up to 7 trials. UCL_R represents the limit of individual R's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute R and the limiting value from the remaining observations.

Notes:

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ISF-QA-016

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GAUGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET
VARIABLE DATA RESULTS

Part Number 23421-K0NA-D000	Gauge Name OBD MICROMETER	Appraiser A PRAKASH
Part Name C1 K0NA	Gauge Number C07L01BR0011-005	Appraiser B ISMILE
Characteristic OBD	Gauge Type VARIABLE	Appraiser C PRASANNA

Characteristic Classification	Trials 3	Parts 10	Appraisers 3	Date Performed 25/06/2019

Measurement Unit Analysis				% Total Variation (TV)		
Repeatability - Equipment Variation (EV)						
EV	=	$R \times K_1$	**Trials** / **K1**	% EV	=	100 (EV/TV)
	=	0.001 x 0.5908	2 / 0.8862		=	100(0.0009/0.0082)
	=	0.0009	3 / 0.5908		=	10.53
Reproducibility - Appraiser Variation (AV)						
AV	=	$\{(X_{DIFF} \times K_2)^2 - (EV^2/nr)\}^{1/2}$		% AV	=	100 (AV/TV)
	=	$\{(0.000 \times 0.5231)^2 - (0.001\,^2/(10 \times 3))\}^{1/2}$			=	100(0.0000/0.0082)
	=	0.0000	Appraisers: **2** / **3**		=	0.00
			K_2: 0.7071 / 0.5231	n = number of parts		
Repeatability & Reproducibility (R & R)				r = number of trials		
R & R	=	$\{(EV^2 + AV^2)\}^{1/2}$	**Parts** / **K₃**			
	=	$\{(0.001^2 + 0.000^2)\}^{1/2}$	2 / 0.7071	% R&R	=	100 (R&R/TV)
	=	0.0009	3 / 0.5231		=	100(0.0009/0.0082)
Part Variation (PV)			4 / 0.4467		=	10.53 ✓
PV	=	$R_P \times K_3$	5 / 0.4030	*Gage system may be acceptable*		
	=	0.026 x 0.3146	6 / 0.3742			
	=	0.0082	7 / 0.3534	% PV	=	100 (PV/TV)
Total Variation (TV)			8 / 0.3375		=	100(0.0082/0.0082)
TV	=	$\{(R\&R^2 + PV^2)\}^{1/2}$	9 / 0.3249		=	99.44
	=	$\{(0.001^2 + 0.008^2)\}^{1/2}$	10 / 0.3146			
	=	0.0082		ndc	=	13.3 ✓

All calculations are based upon predicting 5.15 sigma (99.0% of the area under the normal distribution curve).

K_1 is $5.15/d_2$, where d_2 is dependent on the number of trials (m) and the number if parts times the number of operators (g) which is assumed to be greater than 15.

AV - If a negative value is calculated under the square root sign, the appraiser variation (AV) defaults to zero (0).

K_2 is $5.15/d_2$, where d_2 is dependent on the number of operators (m) and (g) is 1, since there is only one range calculation.

K_2 is $5.15/d_2$, where d_2 is dependent on the number of parts (m) and (g) is 1, since there is only one range calculation.

d_2 is obtained from Table D_3, "Quality Control and Industrial Statistics", A.J. Duncan.