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ANAMET-962
Dial Gauge Comparison Exercise

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This report has been approved by the ANAMET Steering Committee.

ANAMET-962: DIAL GAUGE COMPARISON EXERCISE

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Abstract

This report presents results obtained from a comparison exercise of coaxial connector dial gauge measurements made during the sixth ANAMET meeting, which took place at SESC, DRA Aquila, Bromley, on the 23rd May 1996. The results of the eight participants in the exercise were analysed at the meeting – this report provides a general summary of the exercise.

Introduction

This report presents results obtained from a comparison exercise of coaxial connector dial gauge measurements made during the sixth ANAMET meeting, which took place at SESC, DRA Aquila, Bromley, on the 23rd May 1996. The comparison was assigned the identifier; ANAMET-962, in line with other exercises in the ANAMET series of comparisons.

The decision to undertake such an exercise was made at an earlier ANAMET meeting where it was suggested that participants bring their own gauges to a meeting during which a session would be set aside so that chosen items could be circulated freely around the meeting table.

Eight representatives at the meeting chose to participate in the exercise which consisted of measuring the connector pin recession depth for a range of type-N, 50 ohm, coaxial items. This report presents, anonymously, the results obtained by the participants along with statistical summaries in terms of an average value (the median) and a data scatter indicator (the median absolute deviation from the median).

Comparison details

Seven items were available at the meeting for measurement. The results were input into the ANAMET data analysis programme, as they were generated, for processing. The resulting summary statistics were given to the participants at the meeting enabling them to assess their results with respect to the summary data. The entire exercise took less than an hour to complete (*i.e.*, to do all the measurements, process the results and provide the participants with the statistical summary).

The seven items comprising the exercise (three female and four male) are described in Table 1.

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Results

The results obtained by the participants are given in Table 2. Results which are significantly different (judged by eye) from the majority of values have been presented with a shaded background.

Summary statistics

The participants' results for each item were summarised by providing:

- an average value, in terms of the median [1] of the values;
- a measure of dispersion, in terms of the median absolute deviation (MAD) [2] from the median;
- the range, in terms of the maximum and minimum values obtained by the participants.

The summary statistics are given in Table 3.

Observations

(i) In general, the agreement between the participants was good, especially since the measurements were not made in a laboratory environment. The good agreement is demonstrated by the relatively small MAD values, the largest value being 0.2×10^{-3} inch. This variation is larger than that observed in an earlier ANAMET comparison of GPC-3.5 components [3] where the equivalent largest MAD $\approx 0.1\times10^{-3}$ inch. (This value has been derived from the largest inter-quartile range (IQR) value for the exercise, since IQR $\approx$ 2 $\times$ MAD.)

The larger variation in the type-N measurements could be because these measurements are made with respect to an offset (of approximately 0.2") whereas the GPC-3.5 measurements are made with respect to a flush (or zero offset) reference. It can be postulated that the increased likelihood of a systematic error due to the offset in the type-N measurement will lead to a larger overall variability (*i.e.*, MAD) in the type-N measurements.

(ii) The individual results given in Table 2 show there to be only a small number of outlying, or unusual, values in the results. Participant #3 consistently measured values which were nominally an order of magnitude smaller than the majority of values. Participant #7 produced unusual values (relative to the majority) for items E, F and G.

Conclusions

The exercise demonstrated that on-the-spot measurement comparisons of a relatively simple parameter can be performed successfully. The authors are unaware of any similar exercises ever having been undertaken. The analysis of the results showed good agreement between the majority of participants' values (average MAD $\approx 0.1\times10^{-3}$ inch; worst-case MAD $\approx$ 0.2×10^{-3} inch).

Acknowledgements

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References

[1] N M Ridler, "Making a good estimate of a measurand", ANA*lyse* Note Number 7, January 1995.

[2] N M Ridler and J C Medley, "Assessing the quality of an estimated value - Part 2: the Median Absolute Deviation", ANA*lyse* Note Number 16, April 1996.

[3] N M Ridler and J C Medley, "A comparison of complex scattering coefficient measurements in 50 ohm coaxial line to 26.5 GHz", NPL Report DES 138, June 1995.

Table 1: Descriptions of the seven items used for the comparison.

Connector type	Item code	Identification
Female	A	909F 50 ohm termination
	B	Test port adaptor
	C	Slotted female short
Male	D	909F 50 ohm termination
	E	Open
	F	Open (green)
	G	Short

Table 2: Results obtained by the eight participants for each of the seven items.

Item code	Pin depth measurements ($\times 10^{-3}$ inch) for each participant							
	#1	#2	#3	#4	#5	#6	#7	#8
A	-0.5	-0.6	-0.07	-0.8	-0.7	-0.8	-0.8	-0.5
B	-0.2	-0.4	-0.04	-0.4	-0.3	-0.5	-0.6	-0.2
C	-0.7	-1.0	-0.11	-1.2	-1.0	-1.1	-1.2	-0.8
D	-0.7	-0.7	-0.06	-0.3	-0.7	-0.6	-0.3	-0.8
E	+0.2	+0.2	+0.02	+0.4	+0.1	+0.2	-1.0	+0.2
F	+0.1	+0.2	+0.02	+0.3	+0.1	+0.3	-0.9	0.0
G	-3.5	-3.1	-0.33	-3.0	-3.2	-3.1	+2.5	-3.2

Table 3: Summary statistics produced from the results of the exercise.

Item code	Summary of pin-depth measurements ($\times 10^{-3}$ inch)			
	Median	MAD	Minimum	Maximum
A	-0.65	0.15	-0.8	-0.07
B	-0.35	0.15	-0.6	-0.04
C	-1.00	0.20	-1.2	-0.11
D	-0.65	0.10	-0.8	-0.06
E	+0.20	0.05	-1.0	+0.4
F	+0.10	0.10	-0.9	+0.3
G	-3.10	0.10	-3.5	+2.5