

## Fasteners & Metals Testing Program

### Summary Report # 87 – 3rd Q 2009

**Analysis**  
101

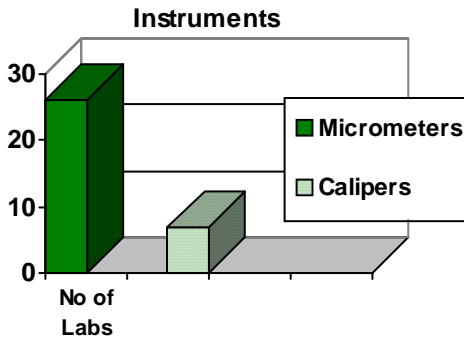
**Analysis Name**  
Round Dimensional

#### Instrument and Method Code List

In the 3rd quarter of 2009, CTS conducted the Test #101 ("Round Dimensional"). For this test all participants received two samples 179 and 180 with nominal diameter 0.25 in. Each sample is an English size X gage pin with 0.00002 in roundness limit made from 52100 bearing steel, hardened to 60-62 Rockwell C. Laboratories were asked to determine the outside diameter of the pins.

### Analysis #101

33 participants from 38 that subscribed for this test reported their testing results.



In this test  
**26** participants used *Micrometers*.  
**7** participants used *Calipers*.  
Testing results for both methods are presented in one table on the following page.

### Analysis of the results

The most convenient and common method of judging the quality of measurement results is by calculating the performance statistic  $E_n$  calculated as:

$$E_n = \frac{X_{lab} - X_{ref}}{\sqrt{U_{lab}^2 + U_{ref}^2}},$$

where now the assigned value  $X_{ref}$  is determined in a reference laboratory,  $U_{ref}$  is the expanded uncertainty of  $X_{ref}$ , and  $U_{lab}$  is the expanded uncertainty of a participant's result  $X_{lab}$ .

Absolute values of  $E_n$  less than 1.0 should be obtained for the measurements to be acceptable.

The following table and the graph represent the results reported by participants. All tests were conducted at room temperature (20-23°C or 68-77F).

$X_{ref}$  and  $U_{ref}$  were determined by the gage pin manufacturer. The manufacturer is ISO 9001:2000 and ISO 9002 Certified company. All master gages used in checking the plug gages are calibrated with standards traceable to NIST.

Round Dimensional - OD of Plain Plug Gage

LabCode	Sample I79						Sample I80					
	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag
<b>Micrometers</b>												
2776	0.24988	0.0002	0.2499	0.00004	-0.098		0.24996	0.0002	0.2500	0.00004	-0.196	
2781	0.24983	0.0003	0.2499	0.00004	-0.231		0.24998	0.0003	0.2500	0.00004	-0.066	
2785	0.24990	0.00005	0.2499	0.00004	0.000		0.25005	0.00005	0.2500	0.00004	0.781	
2797	0.24990	0.0003	0.2499	0.00004	0.000		0.25000	0.0003	0.2500	0.00004	0.000	
2815	0.24990	0.0001	0.2499	0.00004	0.000		0.25000	0.0001	0.2500	0.00004	0.000	
2821	0.24982	0.0003	0.2499	0.00004	-0.028		0.24990	0.0003	0.2500	0.00004	-0.033	
2823	0.24980	0.0001	0.2499	0.00004	-0.928		0.25000	0.0001	0.2500	0.00004	0.000	
2826	0.24989	0.0004	0.2499	0.00004	-0.014		0.25000	0.0004	0.2500	0.00004	0.011	
2884	0.24990	0.00009	0.2499	0.00004	0.000		0.25000	0.00009	0.2500	0.00004	0.000	
2944	0.25000	0.0001655	0.2499	0.00004	0.587		0.25010	0.0001655	0.2500	0.00004	0.587	
3635	0.24978	0.0003	0.2499	0.00004	-0.396		0.24993	0.0003	0.2500	0.00004	-0.231	
3817	0.24974	0.00015	0.2499	0.00004	-1.031	X	0.24986	0.00015	0.2500	0.00004	-0.902	
4015	0.24985	0.0000787	0.2499	0.00004	-0.510		0.24993	0.0000787	0.2500	0.00004	-0.751	
4117	0.24995	0.0002362	0.2499	0.00004	0.206		0.24998	0.0002362	0.2500	0.00004	-0.079	
4242	0.24978	0.00005	0.2499	0.00004	-1.874	X	0.24998	0.00005	0.2500	0.00004	-0.312	
4284	0.24940	0.0005	0.2499	0.00004	-0.997		0.24990	0.0005	0.2500	0.00004	-0.199	
4291	0.25000	0.0005	0.2499	0.00004	0.199		0.25000	0.0005	0.2500	0.00004	0.000	
4385	0.24990	0.0003	0.2499	0.00004	0.000		0.25000	0.0003	0.2500	0.00004	0.000	
4450	0.24959	0.000096	0.2499	0.00004	-2.981	X	0.24966	0.000096	0.2500	0.00004	-3.269	X
4564	0.24983	0.0005	0.2499	0.00004	-0.140		0.24994	0.0005	0.2500	0.00004	-0.120	
5729	0.24986	0.0000787	0.2499	0.00004	-0.421		0.24991	0.0000787	0.2500	0.00004	-1.018	X
6102	0.24996	0.00006	0.2499	0.00004	0.832		0.25000	0.00006	0.2500	0.00004	0.000	
6511	0.24977	0.00003937	0.2499	0.00004	-2.316	X	0.24985	0.00003937	0.2500	0.00004	-2.673	X
6807	0.24976	0.00044	0.2499	0.00004	-0.317		0.24986	0.00044	0.2500	0.00004	-0.317	
6884	0.24988	0.000079	0.2499	0.00004	-0.226		0.24997	0.000079	0.2500	0.00004	-0.339	
6914	0.24980	0.00029	0.2499	0.00004	-0.342		0.25000	0.00029	0.2500	0.00004	0.000	

<b>Calipers</b>												
LabCode	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag
2851	0.24961	0.0018	0.2499	0.00004	-0.161		0.24961	0.0018	0.2500	0.00004	-0.216	
2951	0.25000	0.0026	0.2499	0.00004	0.038		0.25000	0.0026	0.2500	0.00004	0.000	
4080	0.24961	N/A	0.2499	0.00004	N/A		0.24977	N/A	0.2500	0.00004	N/A	
4309	0.24970	0.0003	0.2499	0.00004	-0.067		0.24980	0.0003	0.2500	0.00004	-0.067	
4585	0.24974	0.001758	0.2499	0.00004	-0.091		0.24994	0.001758	0.2500	0.00004	-0.034	
6266	0.25000	0.0013	0.2499	0.00004	0.077		0.25000	0.0013	0.2500	0.00004	0.000	
6887	0.24900	N/A	0.2499	0.00004	N/A		0.24930	N/A	0.2500	0.00004	N/A	

