



## Fasteners & Metals Testing Program

### Summary Report # 85 – 1st Q 2009

**Analysis**  
101

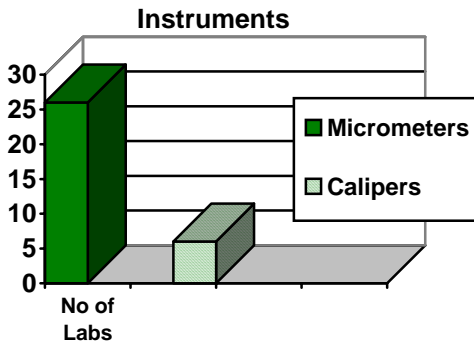
**Analysis Name**  
Round Dimensional

#### Instrument and Method Code List

In the 1st quarter of 2009, CTS conducted the Test #101 ("Round Dimensional"). For this test all participants received two samples 175 and 176 with nominal diameter 0.500 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

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



In this test  
**26** participants used *Micrometers*.  
**6** 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 I75					Sample I76						
	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag	$X_{lab}$	$U_{lab}$	$X_{ref}$	$U_{ref}$	$E_n$	Flag
<b>Micrometers</b>												
2776	0.49994	0.0002	0.5000	0.00004	-0.294		0.50000	0.0002	0.5001	0.00004	-0.490	
2781	0.49991	0.00030	0.5000	0.00004	-0.297		0.49992	0.00030	0.5001	0.00004	-0.595	
2797	0.50000	0.00030	0.5000	0.00004	0.000		0.50000	0.00030	0.5001	0.00004	-0.330	
2815	0.49990	0.00006	0.5000	0.00004	-1.387	X	0.50000	0.00006	0.5001	0.00004	-1.387	X
2823	0.50000	0.00010	0.5000	0.00004	0.000		0.50000	0.00010	0.5001	0.00004	-0.928	
2826	0.49995	0.0003937	0.5000	0.00004	-0.136		0.50002	0.0003937	0.5001	0.00004	-0.190	
2851	0.50004	0.00050	0.5000	0.00004	0.081		0.50009	0.00050	0.5001	0.00004	-0.024	
2884	0.49928	0.00009	0.5000	0.00004	-7.310	X	0.49944	0.00009	0.5001	0.00004	-6.701	X
2907	0.50000	0.00012	0.5000	0.00004	0.000		0.50000	0.00012	0.5001	0.00004	-0.791	
2944	0.49996	0.0001655	0.5000	0.00004	-0.235		0.50008	0.0001655	0.5001	0.00004	-0.117	
3635	0.49995	0.000003	0.5000	0.00004	-1.246	X	0.50004	0.000003	0.5001	0.00004	-1.496	X
3817	0.50008	0.00015	0.5000	0.00004	0.515		0.50006	0.00015	0.5001	0.00004	-0.258	
4015	0.50003	0.0000787	0.5000	0.00004	0.371		0.50002	0.0000787	0.5001	0.00004	-0.851	
4117	0.49985	0.0002	0.5000	0.00004	-0.727		0.49997	0.0002	0.5001	0.00004	-0.638	
4189	0.49992	0.000075	0.5000	0.00004	-0.941		0.50010	0.000075	0.5001	0.00004	0.000	
4242	0.50002	0.00005	0.5000	0.00004	0.312		0.50000	0.00005	0.5001	0.00004	-1.562	X
4284	0.50000	0.001	0.5000	0.00004	0.000		0.50000	0.001	0.5001	0.00004	-0.100	
4291	0.50010	0.0005	0.5000	0.00004	0.199		0.50010	0.0005	0.5001	0.00004	0.000	
4309	0.50000	0.0004	0.5000	0.00004	0.000		0.50000	0.0004	0.5001	0.00004	-0.249	
4450	0.50030	0.000096	0.5000	0.00004	2.885	X	0.50000	0.000096	0.5001	0.00004	-0.962	
4520	0.50010	0.00005	0.5000	0.00004	1.562	X	0.50008	0.00005	0.5001	0.00004	-0.312	
4564	0.49990	0.0005	0.5000	0.00004	-0.199		0.50010	0.0005	0.5001	0.00004	0.000	
5384	0.50000	0.00012	0.5000	0.00004	0.000		0.50010	0.00012	0.5001	0.00004	0.000	
5729	0.49999	0.0000787	0.5000	0.00004	-0.075		0.50014	0.0000787	0.5001	0.00004	0.487	
6102	0.49998	0.00006	0.5000	0.00004	-0.277		0.50008	0.00006	0.5001	0.00004	-0.277	
6266	0.49995	0.00014	0.5000	0.00004	-0.343		0.50005	0.00014	0.5001	0.00004	-0.343	
<b>Calipers</b>												
2785	0.50000	0.0005	0.5000	0.00004	0.000		0.50000	0.0005	0.5001	0.00004	-0.199	
2951	0.49990	0.0026	0.5000	0.00004	-0.038		0.50000	0.0026	0.5001	0.00004	-0.038	
4080	0.49969	N/A	0.5000	0.00004	N/A		0.49993	N/A	0.5001	0.00004	N/A	
4385	0.50000	0.000981	0.5000	0.00004	0.000		0.50000	0.000981	0.5001	0.00004	-0.102	
4585	0.49970	0.0019	0.5000	0.00004	-0.158		0.49990	0.0019	0.5001	0.00004	-0.105	
6511	0.50000	0.0003937	0.5000	0.00004	0.000		0.50000	0.0003937	0.5001	0.00004	-0.253	

