

**Supplemental Information for:**

**Glass-to-glass fusion bonding quality and strength evaluation with time, applied force, and heat**

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**Table S1** – Wilcoxon rank sum tests were conducted for bonding percentage and flexural strength with and without surface activation.

Independent Variable	Wilcoxon rank sum test P-values
	With SAB – Without SAB
Bonding Percentage	1.0000
Flexural Strength	1.000

**Table S2** – Wilcoxon rank sum tests were conducted for bonding percentage and flexural strength between 1 h-2 h, 2 h-4 h, and 1 h-4 h values.

Independent Variable	Wilcoxon rank sum test P-values		
	1 h-2 h	2 h-4 h	1 h-4 h
Bonding Percentage	0.7000	0.2000	0.7000
Flexural Strength	0.4000	0.4000	1.0000

**Table S3**- Wilcoxon rank sum tests were conducted for bonding percentage and flexural strength between 550 N-840 N, 840 N-1110 N, and 550 N-1110 N values.

Independent Variable	Wilcoxon rank sum test P-values		
	550 N-840 N	840 N-1110 N	550 N-1110 N
Bonding Percentage	0.7000	0.2000	0.7000
Flexural Strength	0.7000	0.4000	0.7000

**Table S4-** Wilcoxon rank sum tests were conducted for bonding percentage and flexural strength between 550 °C-650 °C, 650 °C-700 °C, and 550 °C-700 °C values.

Independent Variable	Wilcoxon rank sum test P-values		
	550 °C-650 °C	650 °C-700 °C	550 °C-700 °C
Bonding Percentage	0.1000	0.1000	0.2000
Flexural Strength	1.000	0.4000	0.2000

### Surface Roughness Measurements

Further testing was conducted on the external surface roughness after the bonding procedure to evaluate the finish of the glass wafers. The applications of this bonding process are attractive for application that requires additional deposition of material on the external surface. The surface profile of the wafers is done using a DekTak XT (Bruker, Billerica, MA, USA), where the root mean square average (RMS) of the profile height deviations from the mean line can be calculated with Equation 2:

$$RMS = \left[ \frac{Z_1^2 + Z_2^2 + \dots + Z_N^2}{N} \right]^{1/2} \quad (1)$$

where  $Z$  is the height of all the peaks and valleys, and  $N$  is the number of peaks. The surface profile was measured at 5 general areas on the wafer in two directions: perpendicular and parallel to the primary flat. This gave a total of  $n = 10$  data points per wafer sample, where all the RMS values were calculated for each data point and averaged for each individual wafer.

**Table S5** – Calculated RMS and Wilcoxon rank sum tests were conducted on all samples made for fusion bonding

Bonding Parameter	Testing sample	Calculated RMS (μm)	Wilcoxon rank sum test P-values
Surface Activation Bonding	WOSAB	0.23	1.00 (WOSAB – WSAB)
	WSAB	0.24	
Hold Time	1 h	0.14	0.40 (1 h – 2 h)
	2 h	0.24	0.40 (2 h – 4 h)
	4 h	0.28	1.00 (1 h – 4 h)
Applied Pressure	550 N	0.16	0.70 (550 N – 840 N)
	840 N	0.78	0.40 (840 N – 1110 N)
	1110 N	0.66	0.40 (550 N – 1110 N)
High Temperature	550 °C	0.01	1.83e-4 (550 °C – 650 °C)
	650 °C	0.16	1.83e-4 (650 °C – 750 °C)
	750 °C	1.42	1.83e-4 (550 °C – 750 °C)