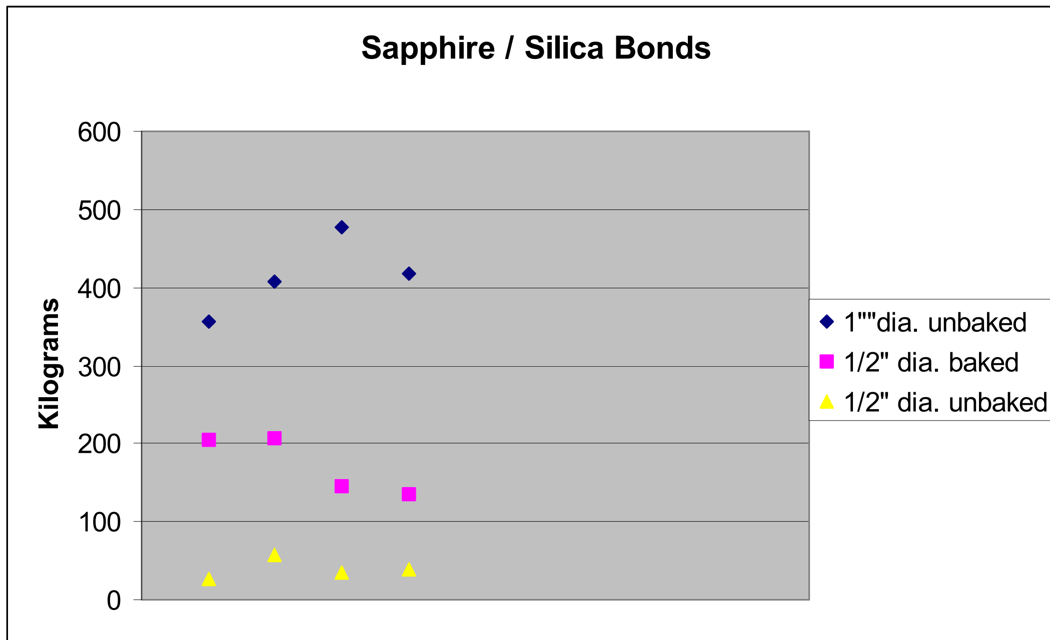
LIGO-T030046-00-D **March, 2003**

Observations on sapphire / silica bonds

When testing sapphire/silica bonds, except for one bonded part that was tested in shear, all the rest of the parts were pulled apart.

The only ½" dia. sapphire/silica bond tested in shear was loaded for 10 days with 37.5 kg. Removed the weight and inspected for damage; did not observe any by looking at the part under a microscope. Reloaded it with 75kg and it separated. There was not damage to sapphire, silica pulled away.

Several sapphire / silica bonds were made. The following chart shows improved strength of sapphire / silica bonds with baking at 120 degrees C, and, strength of 1"dia. bonds made at Stanford.



Stress on silica / sapphire bonds

Substrates 50; 44; 49 baked at 120°C for 24 hrs.
Substrates 45; 48; 47 baked at 60°C for 24 hrs.

Temperature vs. Stress

28º C

30º C

33º C

35º C

After 1 hr @ A
41º C

After cooling back
to room temperature

Stress is observed at ~ 30° C.

Stressed bonds, when pull tested, still had good strength.
After baking at 120 degrees C (an arbitrary temperature) a few parts broke due to stress.
When pulled apart, there was always severe damage to the fused silica where big chunks came off. On some parts, the silica was sliced across the surface.

Conclusion

Silica / sapphire bonds appear to have sufficient strength for Advanced LIGO applications, however, we may need to test more bonds under shear to confirm strength is adequate.