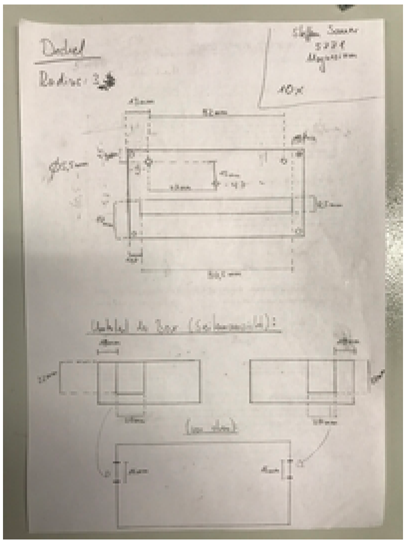
Bake out

- We use the temperature monitoring design, made by E. Wodey, for the out of loop measurements during the out baking.
  - Talk by E. Wodey for the explanation of the monitoring system: 2016-08_geoq_ctp_ew.pdf
  - Box-design made by S. Sauer: 

Bake out list

Item	Material	Maximum temperature [°C]	Comments
Mounting for the spacer	(Al ~ Alplan)	660.2	
Zerodur rods	Zerodur	600	Wikipedia
Viton balls	Viton	280	Wikipedia
Glas balls	Borosilikatglas	500	maximale Arbeitstemperatur, Wikipedia
Heat shields	Aluminium [EN AW-5083]	660.2	<fc #ff0000>Temperatureinsatz (max. °C bei Dauer / Kurzzeiteinsatz): 120/ 180 </fc>
Screws from the mounting and hield shield	Edelstahl A2		

Item	**Material**	**Maximum temperature [°C]**	**Comments**
Windows		200	Question: What is the maximum (continuous) temperature which the AR coatings are able to withstand? What is the maximum temperature gradient that can be applied (continuously) between the two faces of the 1/2“ 3mm BK7 and fused silica windows? Response from Jeremy at Thorlabs: The maximum temperature will be around 200°C or so. We do not spec a maximum temperature gradient since it can depend on the thermal boundary conditions and geometrical boundary conditions of the window. However, I would recommend UVFS over N-BK7 because of its much lower coefficient of thermal coefficient.
Window holder	Aluminium	660.2	
Vacuum chamber	Aluminium	660.2	
CF Cupper ring	Cupper	1084.62	Schmelzpunkt, Wikipedia
CF Flanschkit			
IGP		350	
IGP cable		< 220	
Vacuum pressure sensor		250 without electronics and magnet	
Vacuum pressure sensor cable			
Angle valve		< = 300	
Gate valve		open: < = 250 (max 24h) closed: < = 200	
Sub-D Socket			
Sub-D Feedthrough	Peek	230	
Sub-D Kabel 37FXRR-500	Kupferdraht versilbert Kaptonband-isoliert	250	
CF-Kreuz			
Lead wire	Lead	327	
Indium wire	Indium	155	
Indium foil	Indium	155	
Capton wires	Kupferdraht versilbert Kaptonband-isoliert		
Crimp pins	Cu vergoldet	230	
Peltier-elements		200	
NTC Sensors		300	

Item	**Material**	**Maximum temperature [°C]**	**Comments**
Vacuum glue [Torrseal]		175	Flammpunkt
ULE Spacer			
Mirrors			
ULE rings			
Faraday rotator			
Glue from faraday rotator			

Bake out tips

http://vacuumtunes.co.uk/vtut1.html

3.3 Baking
Early workers baked systems only to about 200C which was effective in removing weakly bound surface water and hydrocarbon molecules. It was not long before it was discovered that baking to higher temperatures was required to remove more tightly bound species and the hydrogen diffusing from the bulk, both of which had the effect of limiting the ultimate system vacuum. The effectiveness of high temperature bakes is amply demonstrated for example by Calder and Lewin (1967), who showed that outgassing could be reduced to about E-16 mbar l/s cm2 by baking for 11 days at 300C or 1 hr only at 635C. Barton and Govier (1968), showed that baking new 18/18/1 stainless steel components at 450C in vacuo, with the exception of traces of hydrogen, successfully removes all gases resulting from the previous history . Interestingly these workers found that gas adsorbed at the surface of stainless steel on re-exposure to atmosphere could be remove by baking at this temperature for 2 to 3 hrs. If pressures only of the order of E-9 mbar were required then sufficient gas could be removed by a 12 hr bake at 200 to 300C; for some applications it is thus worthwhile to use a separate vacuum oven for baking new components at 450C thus avoiding the need for the main system to withstand high temperatures.
Santeler (1991), quotes early work by Aero Vac Corporation which gives valuable data on the effect of baking to different temperatures which is reproduced here below:
Outgassing rates in Torr l/s cm2

BAKING TIME

BAKING TEMP	**20 hrs**	**40 hrs**	**100 hrs**	**200hrs**
150C	6.3E-11	5.3E-11	2.8E-11	2.0E-11
250C	6.3E-12	5.3E-12	2.8E-12	2.0E-12
400C	4.0E-13	1.7E-13	1.0E-13	1.0E-13
500C	8.0E-15	8.0E-16	4.0E-17	8.0E-19

The data above bring home clearly the benefits of high baking temperatures and the diminishing returns from increasing baking time much beyond 20 hrs for baking temperatures up to 400C; at 500C the table shows that it is worthwhile to bake for as long as 200 hrs although one might legitimately question the unusually low value of 8.0E-19 torr l/s cm2 that is quoted. Recent work (Ishikawa, 1995; Ishikawa et al 1991; and Ishikawa and Odaka1990), confirms the values above for lower temperatures but indicates that surface treatments and raw material quality can improve these figures substantially, (section 3.2 above).

Bake out Protocol

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