



**Syrris Ltd.**  
27 Jarman Way, Royston, Hertfordshire  
SG8 5HW, United Kingdom  
T: +44 (0)1763 242555  
F: +44 (0)1763 242992  
E: info@syrris.com  
W: www.syrris.com

**Syrris Limited**  
Registered office as address  
Company No. 6976516

<b>System/Product</b>	Asia
<b>Model/Module</b>	Cryo Controller Cooling Rates
<b>Subject Type</b>	Hardware
<b>Subject Version</b>	1.0
<b>Author</b>	Andrew Mansfield
<b>Date</b>	25/05/2016

## 1 Cooling Rates of Asia Cryo Controller

The following graphs show the cooling rates for both the Asia Microreactors and Tube Reactors.

The cooling rates are dependent on;

- The size of reactor used
- The flow rate set for a given experiment
- The heat capacity of the solvents/reagents used
- The ambient temperature

The % Set Power displayed in the graphs is the power set within the Cryo controller to cool the reactors. It should be noted that this output is not linear and is variable depending on the temperature of the reactor. At higher temperatures the power output is different to that at lower temperatures.

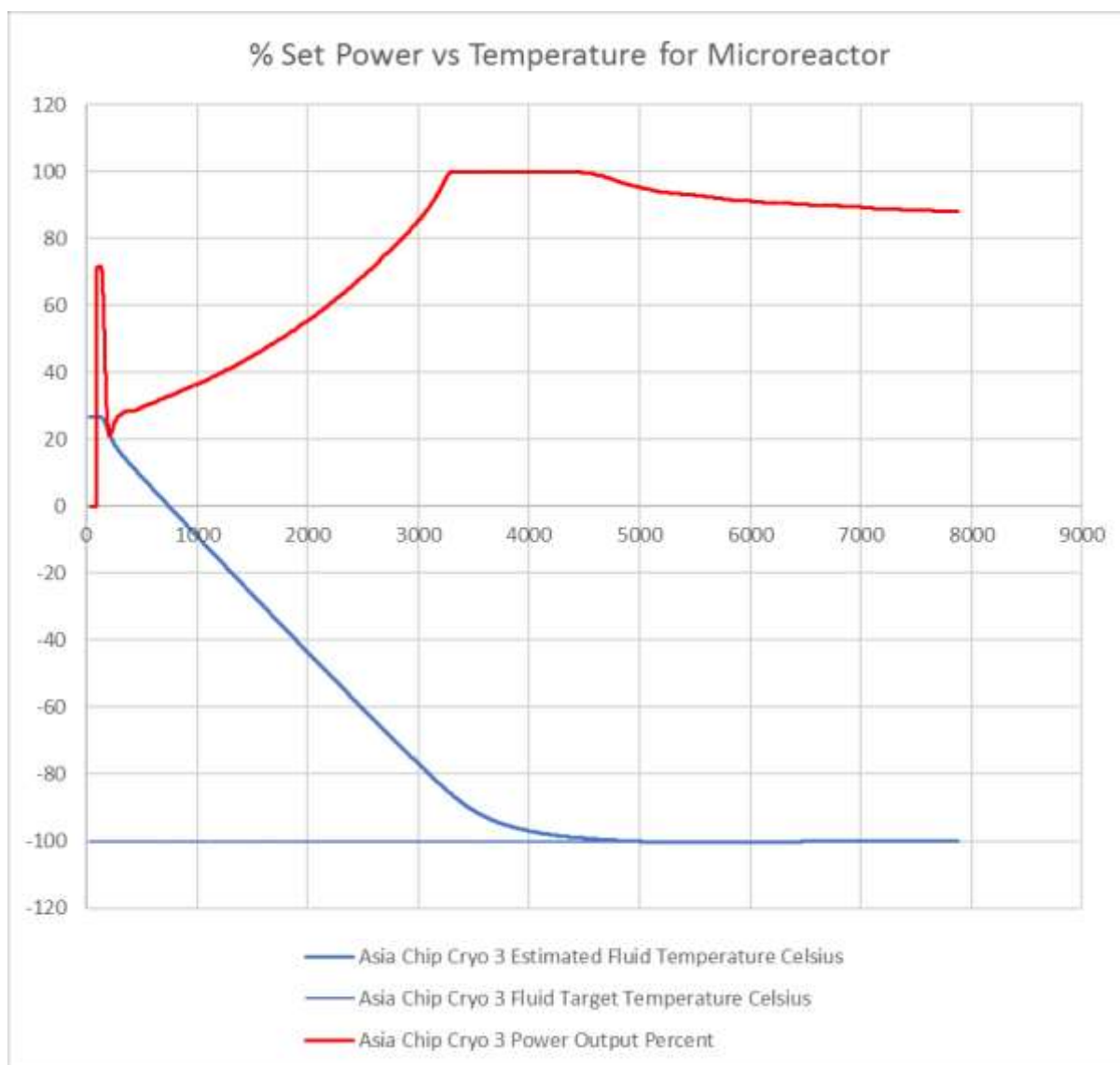
As shown in the graphs once the set temperature is achieved the power supplied to the cooling unit is decreased and therefore a greater cooling capacity is available to control changes in reaction temperature.

Please note that at ambient temperature above 20°C, the lowest achievable reactor temperature may be higher than -100°C for microreactors and -70°C for tube reactors

### 1.1 Asia Microreactor

The minimum achievable temperature for the range of glass microreactors with the Asia Cryo Controller is -100°C.

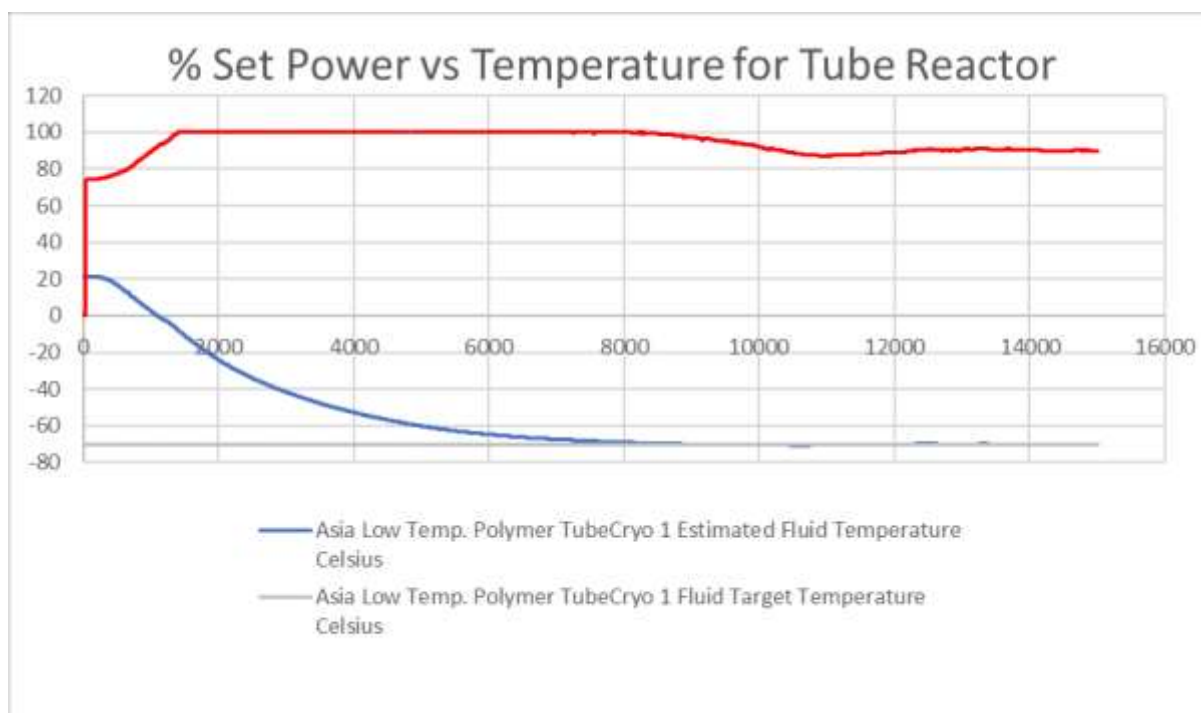
To reach -100oC with microreactors the average time is 75mins.



## 1.2 Asia Cool Tube Reactor

The minimum achievable temperature for the range of tube reactors with the Asia Cryo Controller is -70°C.

To reach -70°C with microreactors the average time is 150mins.



## 2 Cooling Capacity

The following graph shows the cooling capacity of the Cryo Controller's cooling system without the plate adapter and reactor manifold. This shows that at the minimum operating temperature of  $-100^{\circ}\text{C}$  there is  $\sim 15\text{W}$  of cooling power available. At  $-70^{\circ}\text{C}$  there is  $\sim 30\text{W}$  of cooling power. This capacity is however reduced with the addition of the cooling plate and reactor manifolds.

At higher temperatures the cooling capacity of the Asia Cryo Controller is great enough to cope with significant exotherms generated within a given reaction.

It should be noted that because of the greater surface to volume ratio in both microreactors and tube reactors compared with standard round bottom flasks that the temperatures required to perform energetic, exothermic reactions under flow chemistry conditions are typically greater than those using traditional methods.

