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Typ: XELSIUS Reactor

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XELSIUS Cooling Guide

Understanding the XELSIUS System

Version	Date	Subject	Abr.
1.1	14.01.2020	Review	MJ
1.0	28.11.2019	Review	ML
0.1	25.11.2019	Initial	ML

Content

A Preface

This manual helps to commission and to operate the device safely and smoothly. The instructions must therefore be read carefully before use. Read this manual before using the equipment.

Please keep this manual accessible to all users at all times.

In these operating instructions, the following safety symbols are used. They are intended to alert the reader to the associated safety instructions in the text.

This symbol indicates risks to people, equipment, materials or the environment

The documentation has been prepared with care. The product described is constantly evolving. Therefore, the documentation is not in every case checked for consistency with performance data, standards or other characteristics are not a form of guarantee in legal aspects.
If it contains technical or editorial errors, we reserve the right to make alterations at any time and without notice.

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B Safety Information

Safety Instructions

- The XELSIUS Reactor must be used with an appropriately rated cooling system at all times, even when the equipment is only used for heating applications.

- Failure to use an appropriately rated cooling system will negatively impact the performance of XELSIUS.
  It could reduce the lifespan of the product, increase service frequency or cause damage of the equipment.

- Damage caused to the XELSIUS Reactor by using inappropriately rated cooling systems is not covered under warranty.

- Damage caused to the XELSIUS Reactor by using inappropriately cooling liquides (unfilterd, contaminated or wrong liquids) is not covered under warranty.

C Learn about XELSIUS and the cooling system

XELSIUS

XELSIUS is capable of independently cooling, heating and stirring each of its 10 cells down to a minimum temperature of at least -20 °C, but this is only achievable when the product is coupled to a cooling system that can remove heat at a rate greater or equal to that collected by the XELSIUS system.

It is important to understand the importance of this relationship and to select an appropriate cooling system so that you can achieve the performance needed for your application and get the results you expect.

Each of the XELSIUS Reactor cells contains its own Peltier cooling/heating device. While operating in cooling mode, these devices remove heat from the reaction vessel and pass it onto the cooling system via a heat exchanger.

The temperature of the coolant increases which is then pumped out of the reactor, where it's cooled by the chiller/cooling system and rejected into the air.

It is important to note that even when a cell is heating and not using the cooling feature, a cooling system is still required to ensure damage is not sustained to the sensitive cells during operation.

If the cooling system is unable to transport the heat produced inside the system in time, the performance (minimum temperature/ colling rates) will be effected negatively.

Factors defined by Reaction

Factors which contribute to the load on the cooling system:

- The number of cells being cooled
  Cooling 10 cells in parallel places a higher load on the cooling system than only cooling a lower number in parallel

- The cooling rate
  Cooling at a rate of 5 °C/minute places a higher load on the cooling system than cooling at 1 °C/minute.

- The minimum temperature required.
  Cooling down to a temperature of -25 °C places a higher load on the cooling system than cooling down to a temperature of 0 °C

- Heat of the reaction
  Strong exotherm reactions places a higher load than endotherm reactions

Cooling Liquid

Once you have selected your cooling system, you will need to follow the manufacturer's recommendation and use a fluid suitable for your application. Only use anti-freeze fluids designed specifically for lab equipment.

When working with refrigerated and other cooling equipment, it is important to use a fluid that will not freeze because the temperature inside the cooling equipment may be significantly colder than the set temperature.

Water-based synthetic fluids are popular choices for cooling. They can be used across a broad temperature range. Glycols, when mixed with water, become antifreeze.There are two glycols which are commonly used: Ethylene glycol (EG) and propylene glycol (PG). Of the two, EG has slightly better thermal properties and can cool in a broader temperature range. However, it is highly toxic and not usable in all applications. In those cases, PG is a good alternative. We recommend mixing with distilled water.

Parameter Summary

The main paramters for a cooling systems are:

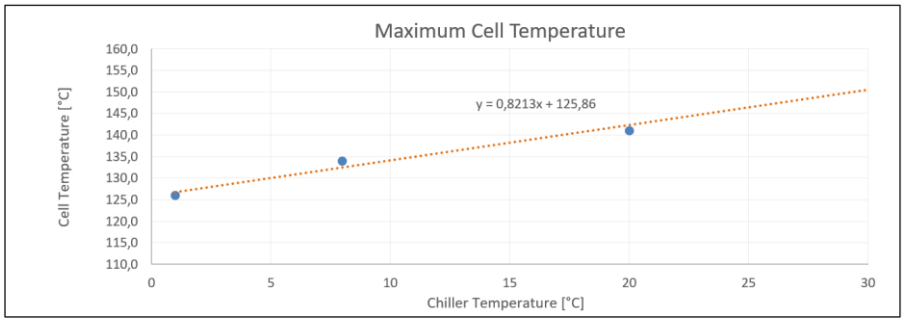
- Working Temperature Range
  typically: 1 °C – 30 °C
- Cooling Capacity Chiller
  typically: 1 kW in the range of 0 °C - 15 °C
- Flow Rate
  mimum flow rate 3,0 l/min
  maximum flowrate 20,0 l/min
- Pressure
  specified between 1,0 bar and 2,0 bar
- Filtering Requirements
  Inline filter: 50 micron
- Cooling Liquid
  water or water/glycol mixtures

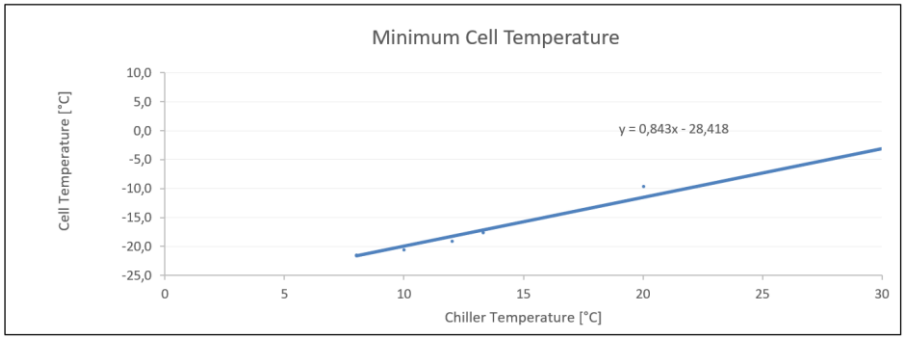
Working Temperature Range

The main parameter to consider when defining a coolersystem is the working temperature range.

The working temperature you use will be subjective to your experiment and is typically determined empirically.

Here some parameter settings out of our practical experiences with the XELSIUS system.
Chiller: Huber, Unichiller 010 Olé
Flow rate: 10,0 l/min
Ambient temperatrure: 23 °C
Running 10 cell parallel with max cooling / heating temperature.





Results

Maximum Cell Temperatures

Chiller Temperature [°C]	Cell [°C]	+/-	Criterion
35,0	155,0	1,5	> 150
20,0	141,0	1,0	> 140
8,0	134,0	1,5	> 120
1,0	126,0	1,5	

Minimal Cell Temperatures

Chiller Temperature [°C]	Cell [°C]	+/-	Criterion
40,0	4,7	0,8	< 0
20,0	-9,6	1,0	
13,3	-17,6	1,5	< -15,0
12,0	-19,0	1,6	
10,0	-20,5	1,5	
8,0	-21,5	2,5	< -20,0

How to use the diagram?

With a working temperatur of 20 °C, (here provided by a Huber Unichiller 010 Olè with a minimum flowrate of 3,0 l/min) and running the XELSIUS with 10 cell parallel the reachable jacket temperatures will be:
lowest temperture: -10 °C
highest temperature 140 °C

With a working temperature of 8 °C cooling of the jacket will be at approx. -21 °C, while maximum temperature will be approx 134 °C.

Cooling Capacity

The cooling capacity is a characteristic of a chiller which determines the performace and the speed of the cooler. The cooler needs a capacity greater or equal than that produced within the the reactor.

It is recommended that you select a product with a cooling capacity of at least 1.0kW (1000W) between the working temperature of range
of 15 °C to – 5 °C

Cooling Capacity: for example, Huber Unichiller 010 Olé

Working Temp	15 °C	0 °C	-10 °C	-20 °C
Cooling Capacity	1,0 kW	0,8 kW	0,5 kW	0,15 kW

It is recommended to use the warmest working temperature possible which achieves your performance requirements to avoid unnecessary condensation and to avoid wasting energy.

If the colling capcity of your cooling system is not strong enough your cooler will not be able to hold the set temperature.

Please note that the cooling capacity decreases significantly when the working temperature is reduced.

Flow Rate

Flow Rate is also a very importat parameter for your cooling system.
Physically determined heatexchange is like other transport processes a kinetic phenomea. The cooler should be capable of providing coolant at a rate of

typically mimum flow rate 3,0 l/min and
maximum flowrate 20,0 l/min

Higher flowrater are usefull to reach lower jacket temperatures, while lower flow rates are favorable for higher tempartures.

In every case you must ensure that the supply of 3 Litres per minute is maintained for the duration of your work, even if you share your colling system with other devices.

Do not compromise the flow rate of the coolant into the XELSIUS by using incorrectly specified ancillary items such as couplers, reducers or tee-pieces, for example.

Pressure

In order to obtain the flow rate discussed above, the coolers pump must be capable of providing a pressure of at least 1 bar effective at the XELSIUS system.

You must ensure that the pressure of at least 2 bar is maintained for the duration of your work.

If the flowrate and pressure are not effective to the XELSIUIS system it may cause overtemperatures within the reactor system.
At a temperature higher than 60 °C inside the of reactor, due to safety reasons the power supply for the cells will be terminated.

Other

If you use colling system with lower specifications it may be that you could not reach the full potential of the XELSIUS and may not meet the performance characteristics required by your work.

When coupling your XELSIUS to a a cooling system it is required that you also fit a 50 micron inline filter (if one is not present in the cooler) to prevent the ingress of contaminates into the cell heat exchangers. The filter should be installed on the outlet of the chiller.

Partial restriction or blockage of heat exchangers caused by contaminates will impact the system performance and potentially void your warranty.