

**DrySyn COOL performance tests with Huber Ministat 230 and 240 Series**

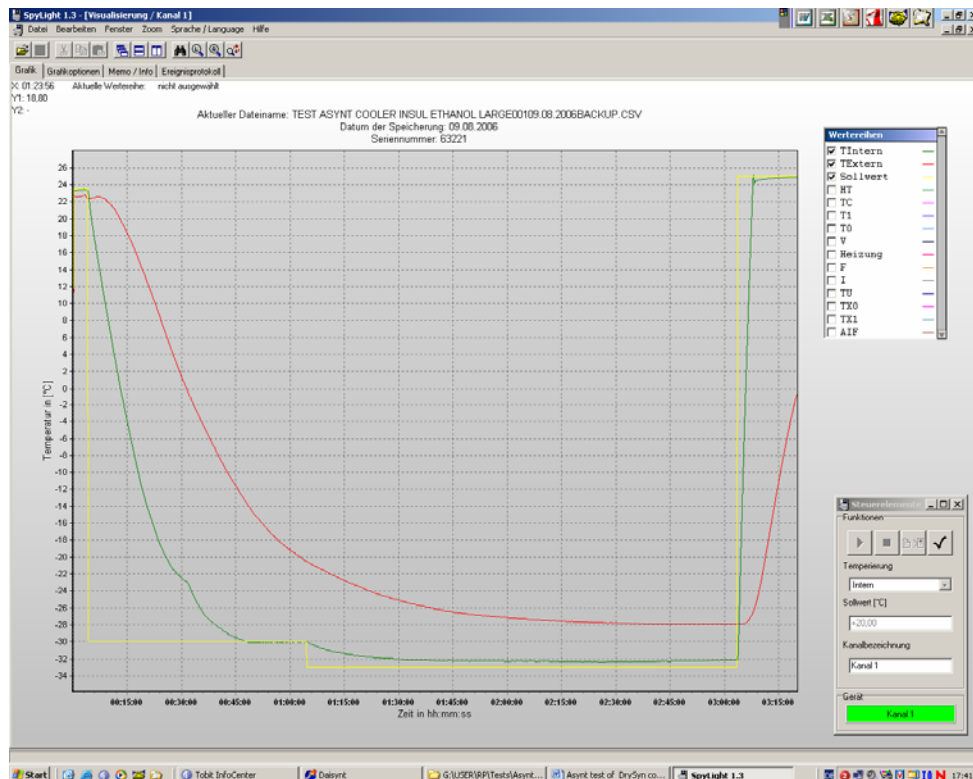
All tests were carried out independently by Huber technical staff in Offenburg, Germany.

**Test One - Round bottomed flask (1000mL), insulated, using ethanol as thermal fluid and Huber Ministat 230 system.**

Huber Ministat 230 with ethanol as the thermal fluid and a round bottomed flask (1000mL) was filled to 1/3 full with Ethanol. The DrySyn Cool was connected using 1 meter Perbunan flexible hoses to the Huber Ministat. The set point was positioned at -30°C. The DrySyn Cool was insulated with Armaflex material (please see image at end of report) Both connecting hoses, the cooling plate and flask were wrapped in insulation to reduce heat from the external environment. The bottom of the plate was not insulated as it was shielded by a Teflon disk.

In all graphs, red is the flask contents temperature, green is machine bath temperature (the outlet temperature) and yellow is the set point.

**Round bottomed flask (1000mL), insulated, using Ethanol as thermal fluid and Huber Ministat 230**



### **Conclusion Test One.**

The minimum temperature reached by the Huber Ministat 230 was -32.3°C. The minimum temperature reached by the flask contents was -27.9°C.

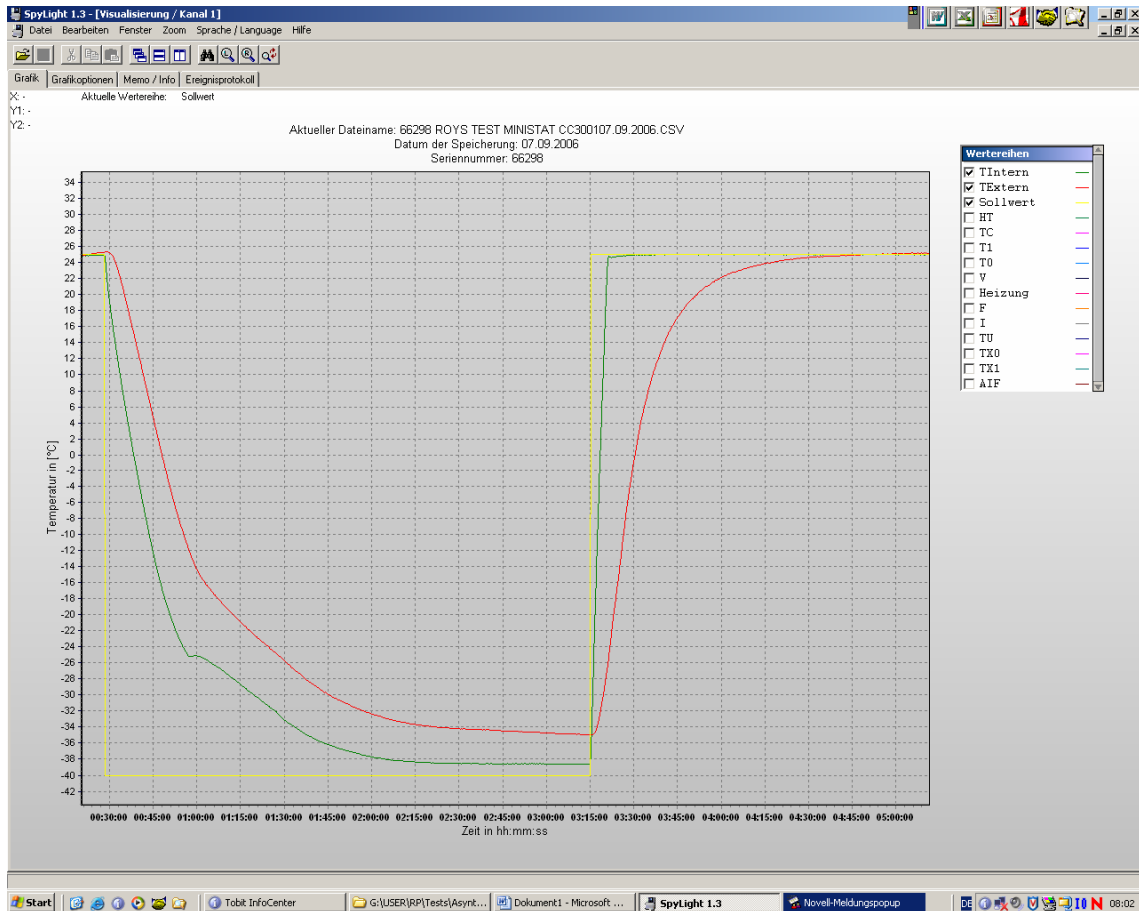
At the end of the test, the temperature was raised to +25°C allowing ice to melt. The inside of the cooling cup (which contains the flask) was inspected and appeared dry.

### **Test Two - Round bottomed flask (1000mL), insulated, using ethanol as thermal fluid and Huber Ministat 240 system.**

Huber Ministat 240 with ethanol as the thermal fluid and a round bottomed flask (1000mL) was filled to 1/3 full with Ethanol. The DrySyn Cool was connected as previously described in Test One. The set point was positioned at -40°C. The DrySyn Cool was again insulated with Armaflex. Both connecting hoses, the cooling plate and flask were wrapped in insulation to reduce heat from the external environment. The bottom of the plate was not insulated as it was shielded by a Teflon disk. A PT100 sensor was placed into the Ethanol to measure the internal temperature of the flask contents.

### **Round bottomed flask (1000mL), insulated, using Ethanol as thermal fluid and Huber**

## Ministat 240



### Conclusion Test Two.

The minimum temperature reached by the Huber Ministat 240 was  $-38.5^{\circ}\text{C}$  after 2 hours and 15 minutes. The minimum temperature reached by the flask contents was  $-35.0^{\circ}\text{C}$  after 3 hours and 15 minutes. It is possible it would have dropped a little further if experiment had been left longer. At the end of the test, the temperature was raised to  $+25^{\circ}\text{C}$  allowing ice to melt. The inside of the cooling cup was inspected and appeared dry.

### Overall Conclusions

It is shown conclusively that the insulated DrySyn Cool, using Ethanol as a thermal fluid, can reach flask contents temperatures of up to  $-35^{\circ}\text{C}$  depending upon the type of Huber Ministat used. Potentially lower temperatures could be obtained depending upon the model of circulator.



**Un-insulated DrySyn Cool, pictured with a 100ml flask**



**Fully insulated DrySyn Cool.**