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Sample Environment at Neutron Scattering Facilities
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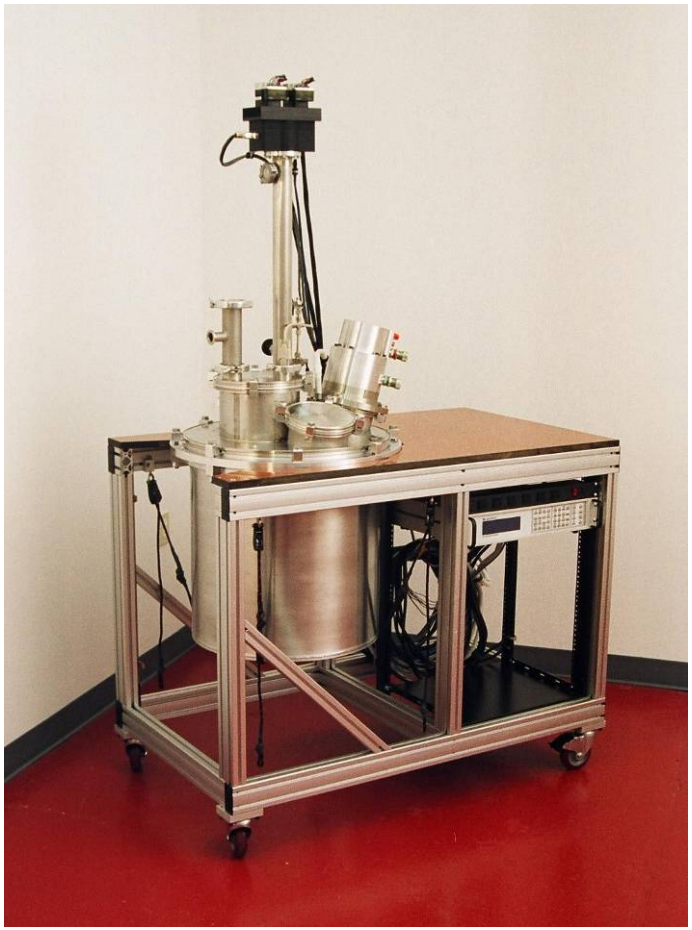
The Fast Exchange Refrigerator for Neutron Science (FERNS) enables 24 sample "cans" per cycle to be inserted and retrieved in a cryogenic environment. A video camera acquires a unique identification marked on the sample can to provide a record of the sequence. All operations are coordinated via a LabView™ program that can be operated locally or over a network. The samples are contained in vanadium cans 6-10 mm in diameter and equipped with a hermetically sealed lid that interfaces with the sample handler. The system uses an ARS model DE-210 closed cycle refrigerator for cooling. The sample is delivered to a pre-cooling location that is at a temperature of ~25K, after the several minutes, the sample is moved on the "landing pad" that is held at ~10K and locates the sample in the probe beam. After the sample is released onto the landing pad, the sample handler is retracted. Reading the sample identification and the exchange operation takes approximately 2 minutes. The time to cool the sample from ambient temperature to ~10 K is approximately 8 minutes including the pre-cooling time. The cooling time increases to approximately 12 minutes if pre-cooling is not used. A resistive heating coil can be used to offset the cooling engine so that temperatures up to ~400 K can be accessed and controlled using a PID control loop. The recovery time after heating the sample well from 10 K to 250 K and back down is approximately 20 minutes. Design details and results of in progress testing will be presented. The "Fast Exchange Refrigerator for Neutron Science" (FERNS) project is funded by the Department of Energy's Small Business Innovation Research program.

FERNS
Fast Exchange Refrigerator for Neutron Science



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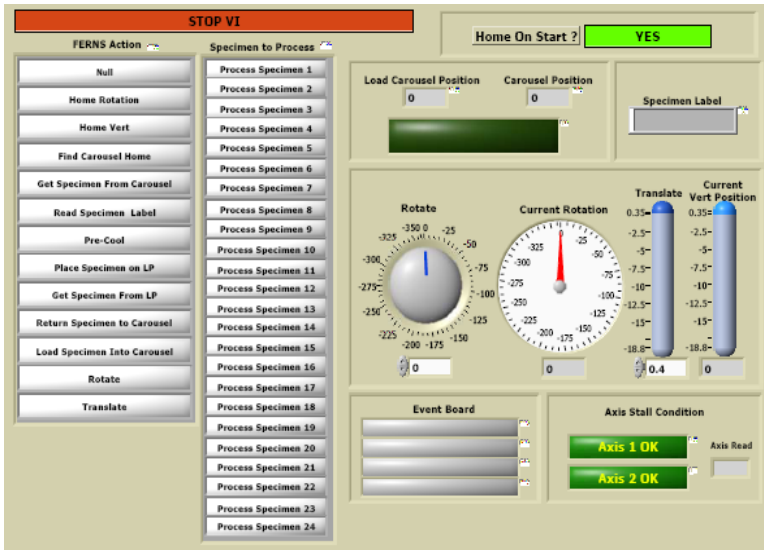
FERNS
LabView™ Control Panels

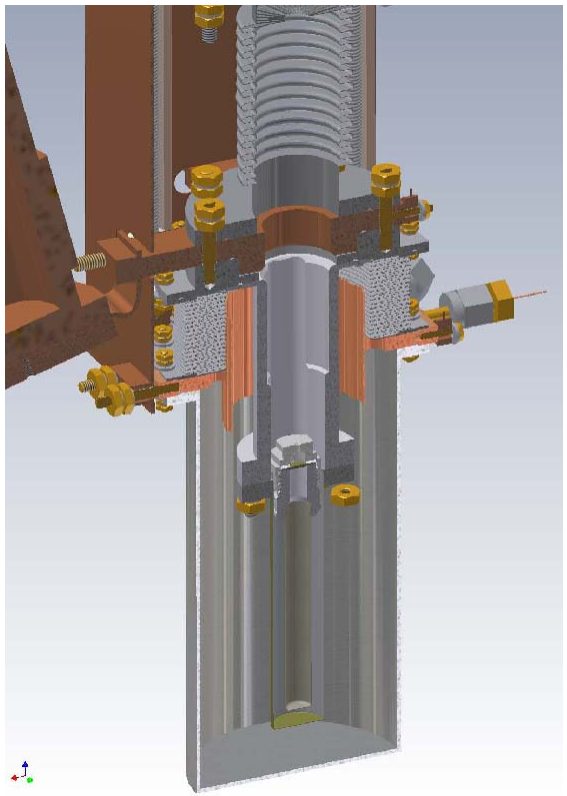
Main Event Control Panel

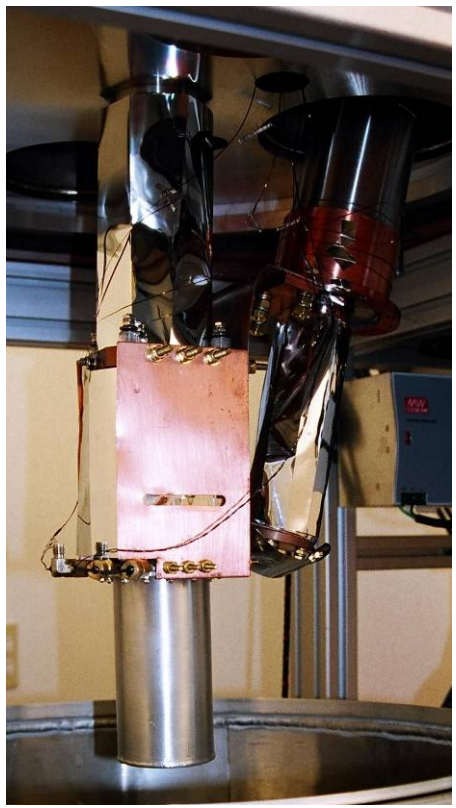


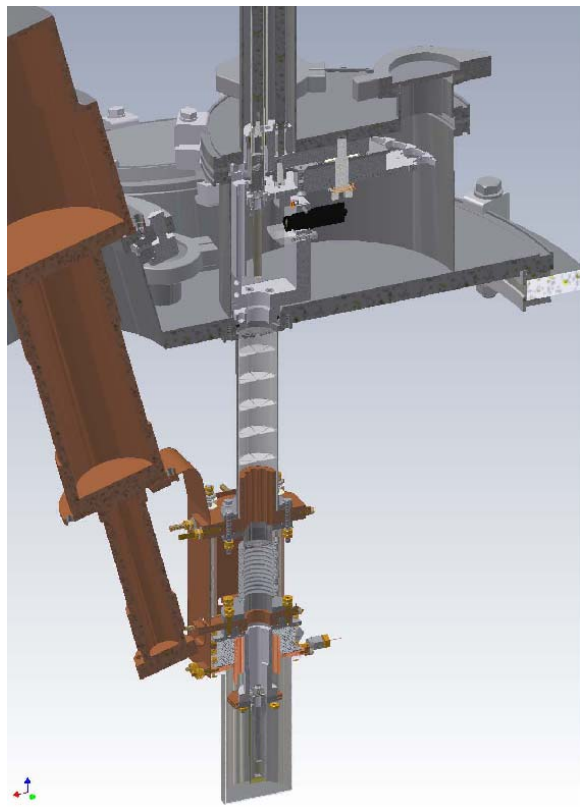
Data Sockets

Terminal Control Panel

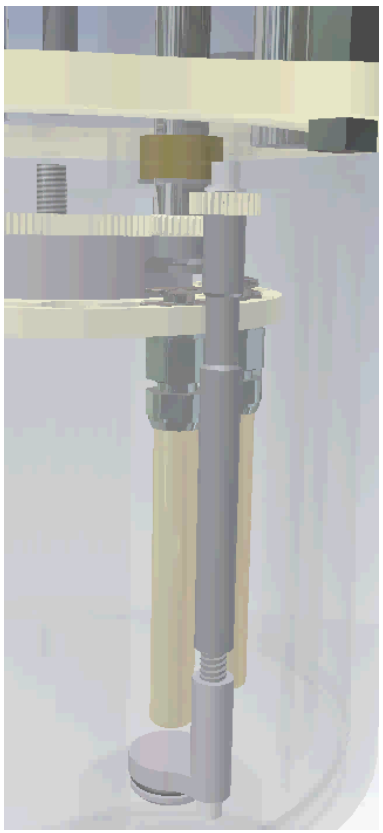
FERNS
Sample Well

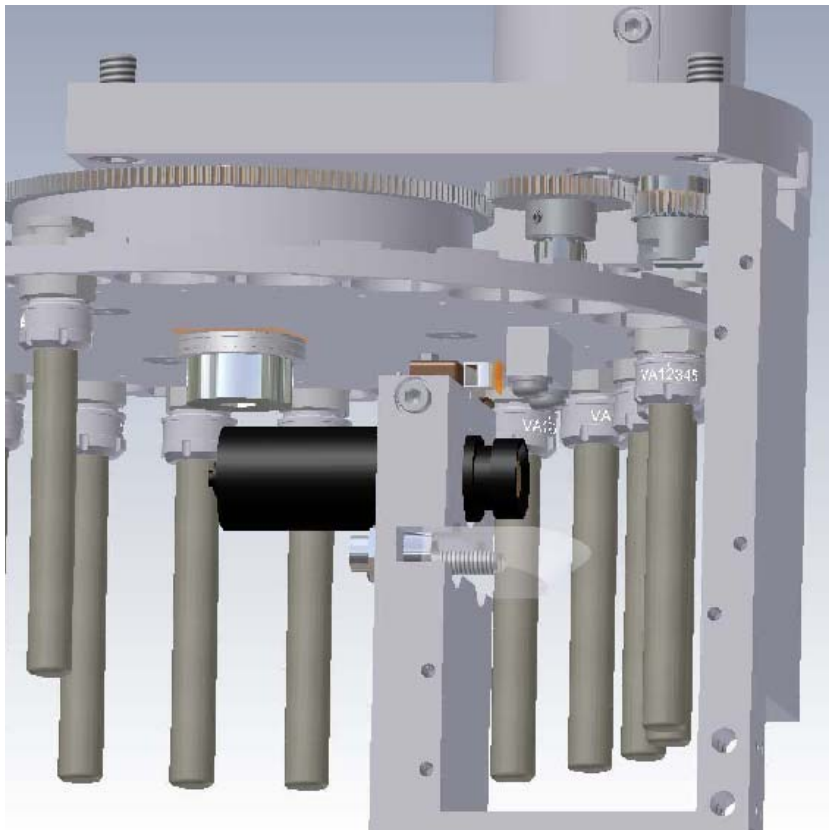


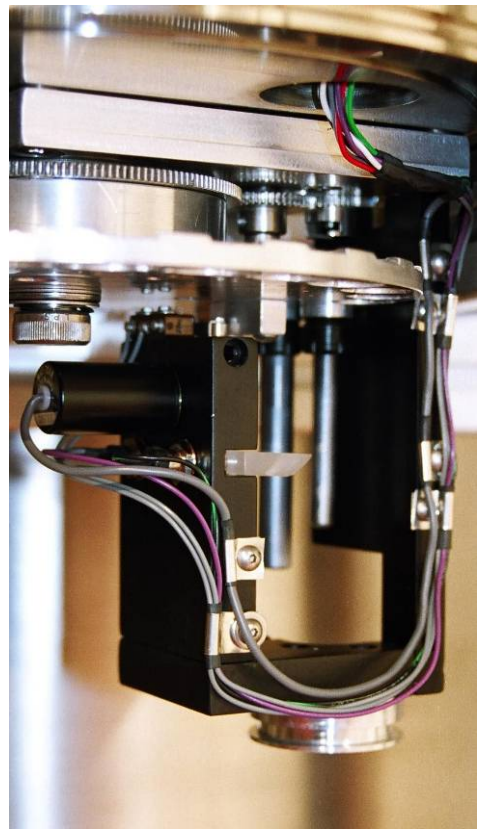




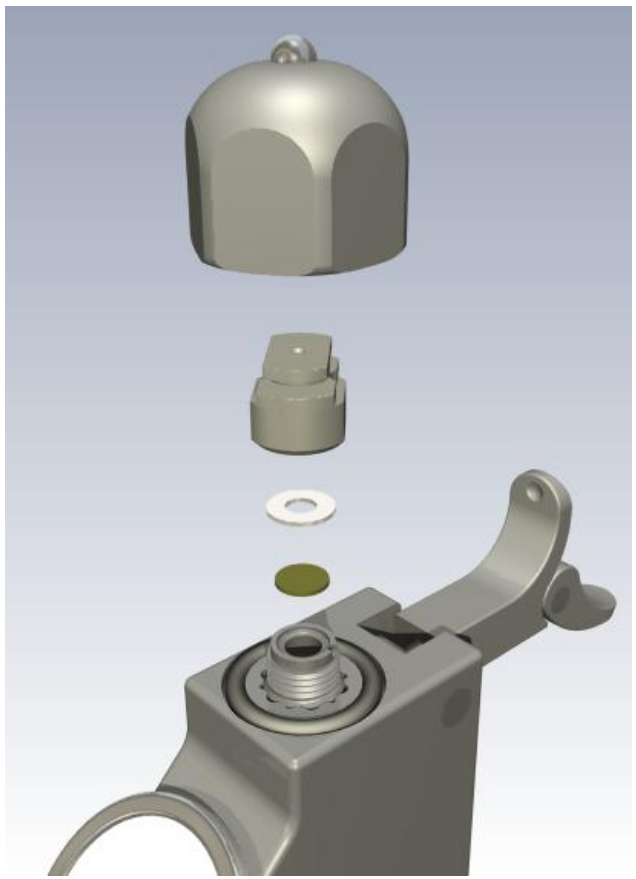
FERNS
Sample Exchange, Carousel and Machine Vision

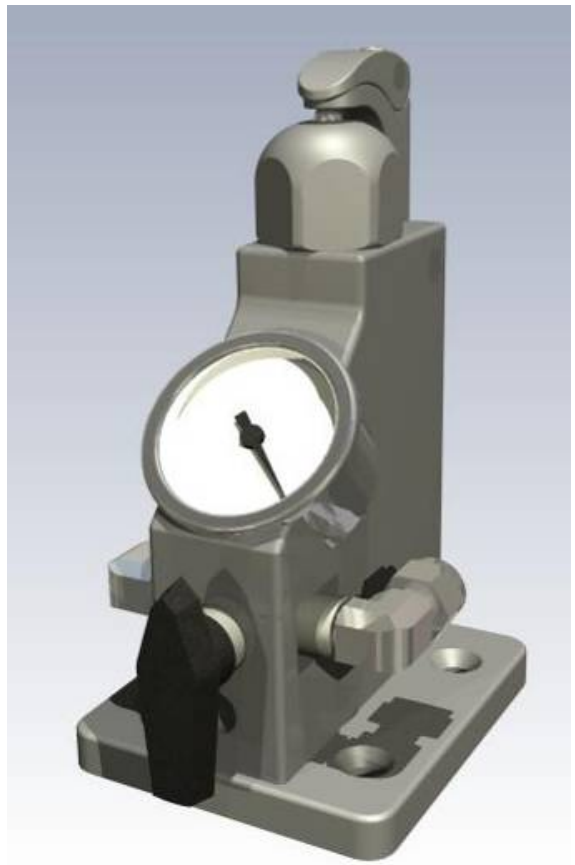




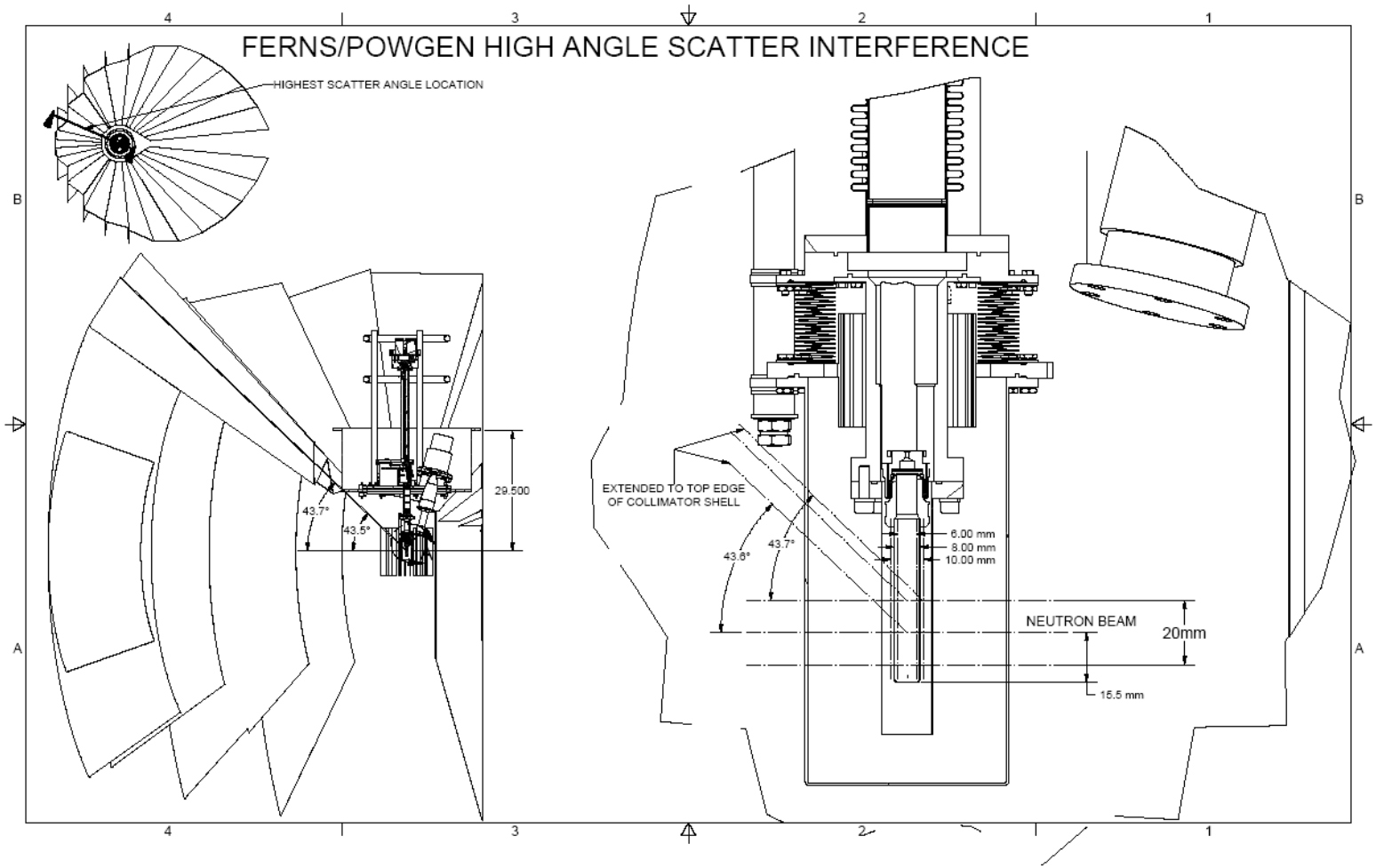


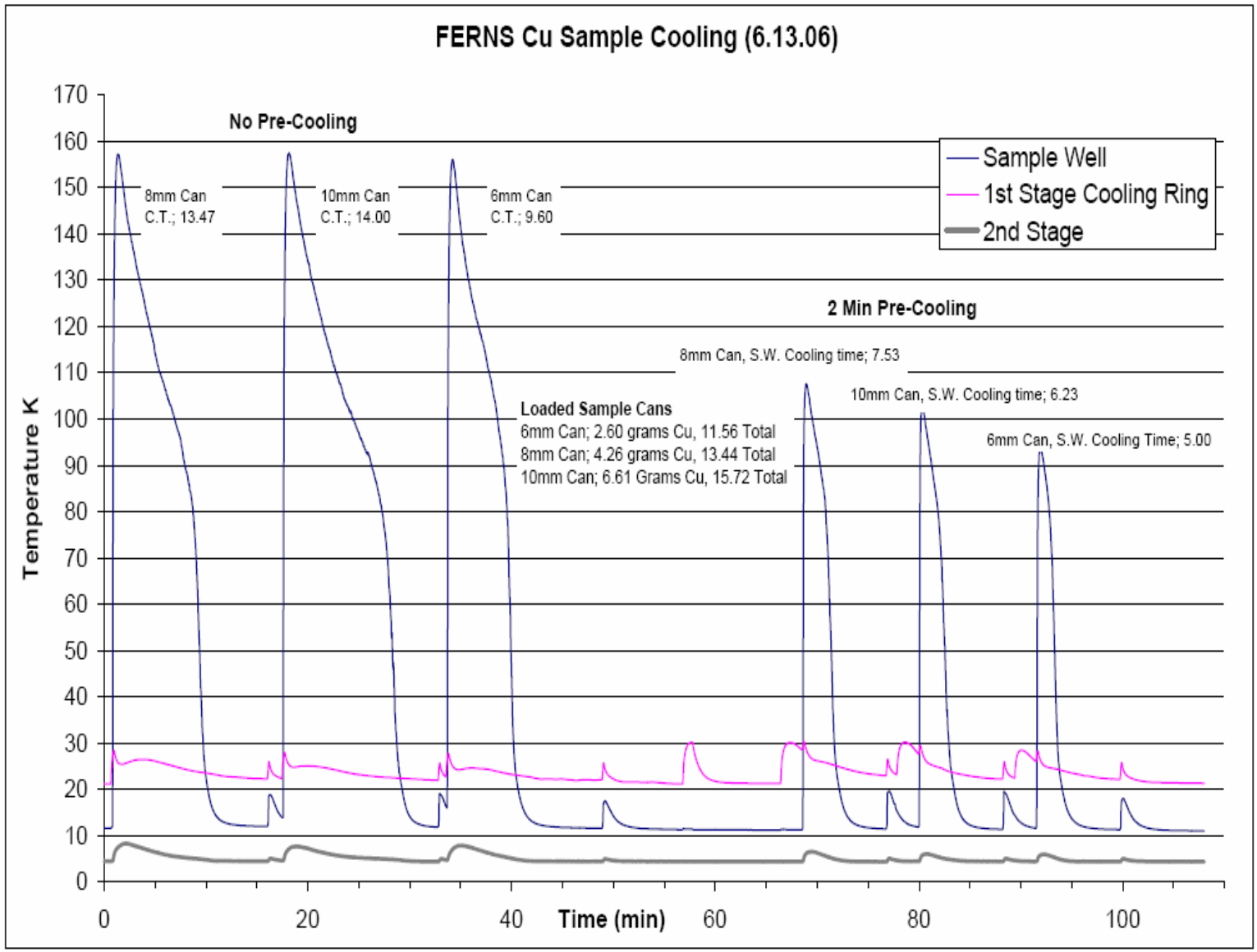
FERNS
Sample Can and Prep

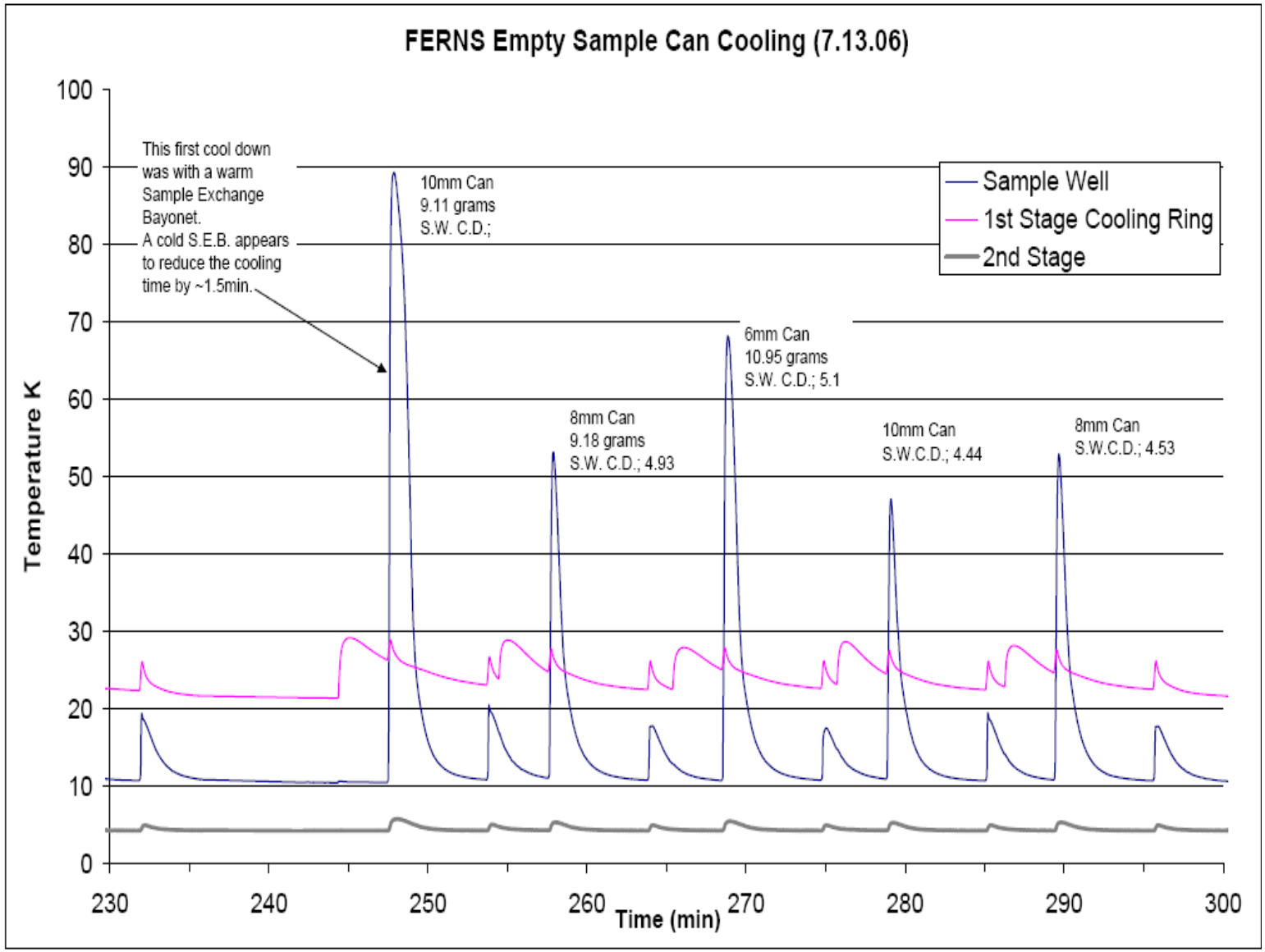


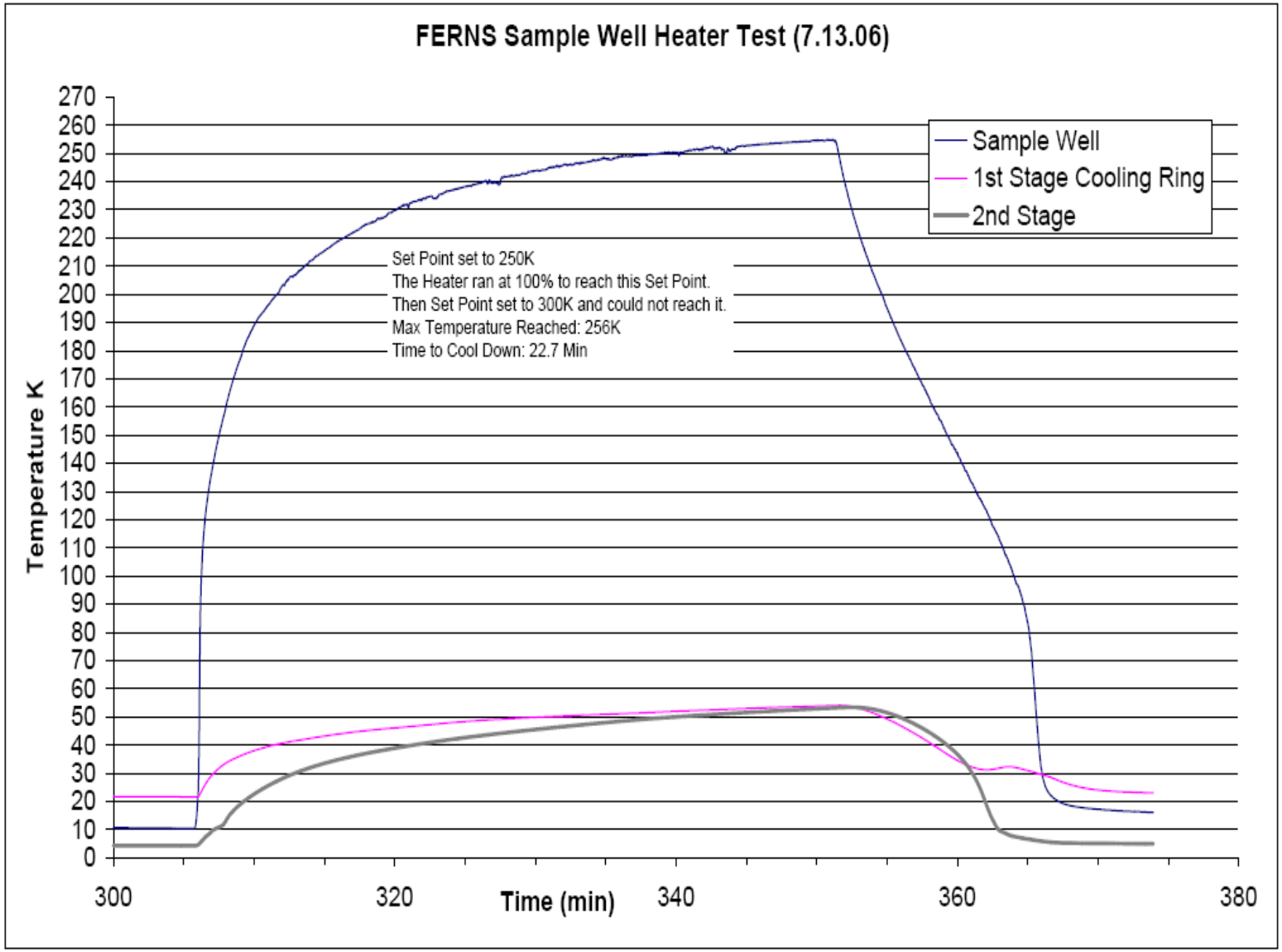


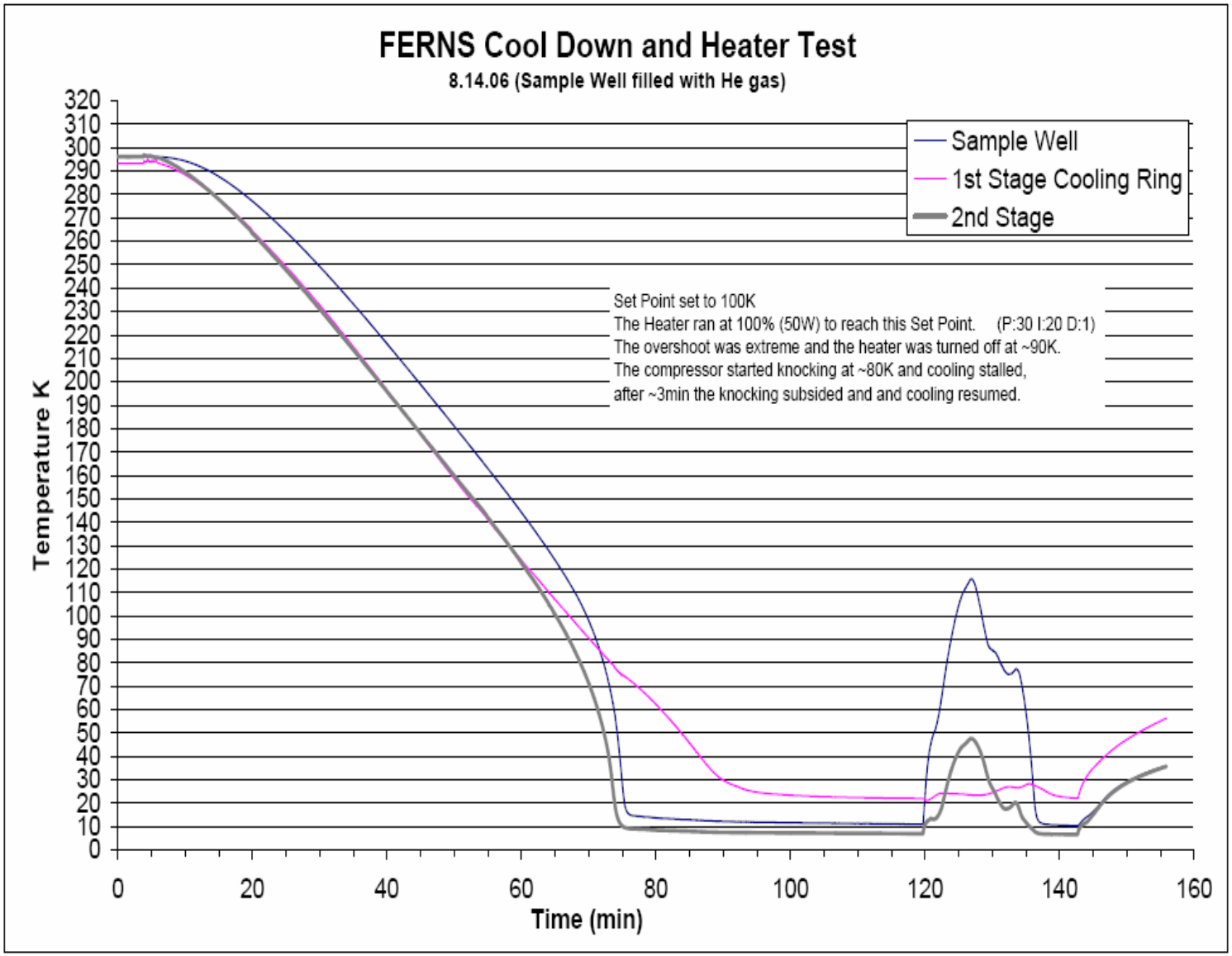
FERNS
Neutron Scatter Discussion



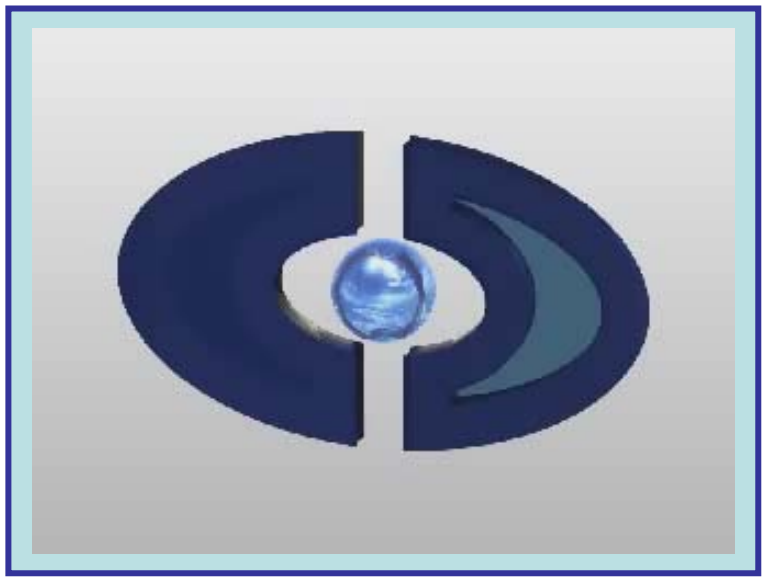

FERNS Cu Sample Cooling (6.13.06)
Temperature K
Time (min)
No Pre-Cooling
8mm Can
C.T.; 13.47
10mm Can
C.T.; 14.00
6mm Can
C.T.; 9.60
Sample Well
1st Stage Cooling Ring
2nd Stage
2 Min Pre-Cooling
8mm Can, S.W. Cooling time; 7.53
10mm Can, S.W. Cooling time; 6.23
6mm Can, S.W. Cooling Time; 5.00
Loaded Sample Cans
6mm Can; 2.60 grams Cu, 11.56 Total
8mm Can; 4.26 grams Cu, 13.44 Total
10mm Can; 6.61 Grams Cu, 15.72 Total
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
0
20
40
60
80
100


FERNS Empty Sample Can Cooling (7.13.06)
Temperature K
Time (min)
100
90
80
70
60
50
40
30
20
10
0
230
240
250
260
270
280
290
300
This first cool down was with a warm Sample Exchange Bayonet.
A cold S.E.B. appears to reduce the cooling time by ~1.5min.
10mm Can
9.11 grams
S.W. C.D.;
8mm Can
9.18 grams
S.W. C.D.; 4.93
6mm Can
10.95 grams
S.W. C.D.; 5.1
10mm Can
S.W.C.D.; 4.44
8mm Can
S.W.C.D.; 4.53
Sample Well
1st Stage Cooling Ring
2nd Stage


FERNS Sample Well Heater Test (7.13.06)
Temperature K
Time (min)
Sample Well
1st Stage Cooling Ring
2nd Stage
Set Point set to 250K
The Heater ran at 100% to reach this Set Point.
Then Set Point set to 300K and could not reach it.
Max Temperature Reached: 256K
Time to Cool Down: 22.7 Min
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
300
320
340
360
380


FERNS Cool Down and Heater Test
8.14.06 (Sample Well filled with He gas)
Sample Well
1st Stage Cooling Ring
2nd Stage
Set Point set to 100K
The Heater ran at 100% (50W) to reach this Set Point. (P:30 I:20 D:1)
The overshoot was extreme and the heater was turned off at ~90K.
The compressor started knocking at ~80K and cooling stalled,
after ~3min the knocking subsided and and cooling resumed.
Temperature K
Time (min)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
0
20
40
60
80
100
120
140
160

Thank You



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