

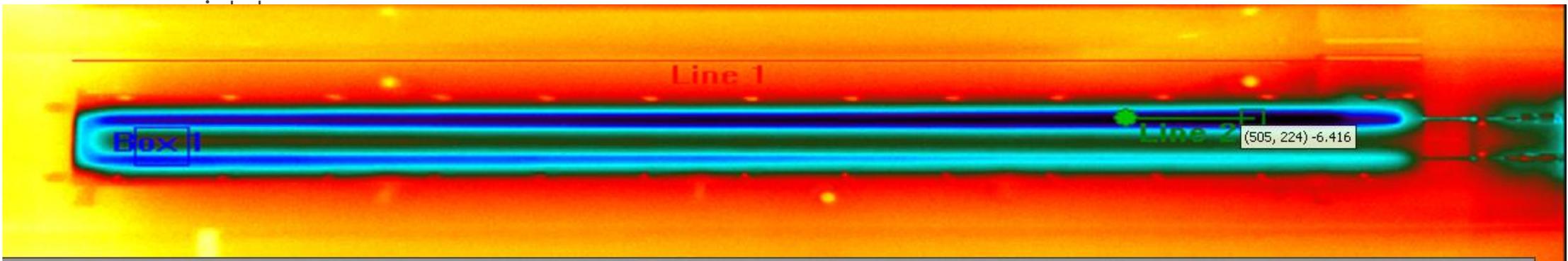
Thermal QC Update: Shock Test of Stave Core

WILLIAM HEIDORN
IOWA STATE UNIVERSITY
ISU WEEKLY STAVE QC MEETING
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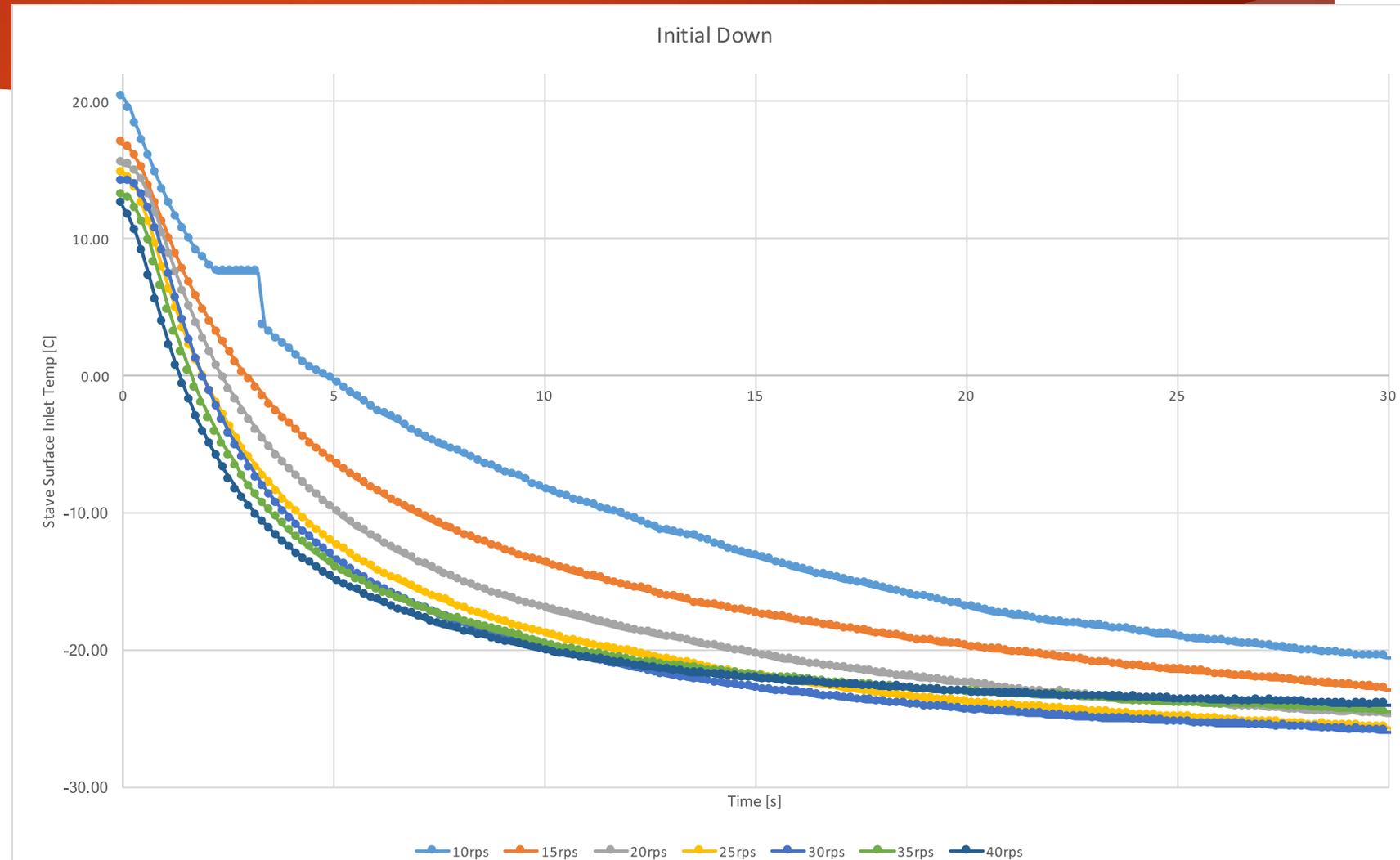
Flow Rate Experiments

- ▶ Attempted to get faster automated flow rates through the stave core and find the “best” rps setting
- ▶ Ran 7 different pump settings(10,15,20,25,30,35,40) with -55C set fluid temperature
 - ▶ Look at average temperature along cooling pipe at green line
 - ▶ Did this twice once with 5psi airflow in and once with no airflow
 - ▶ Noticed thermocouples were not correct. Outlet was generally colder than inlet



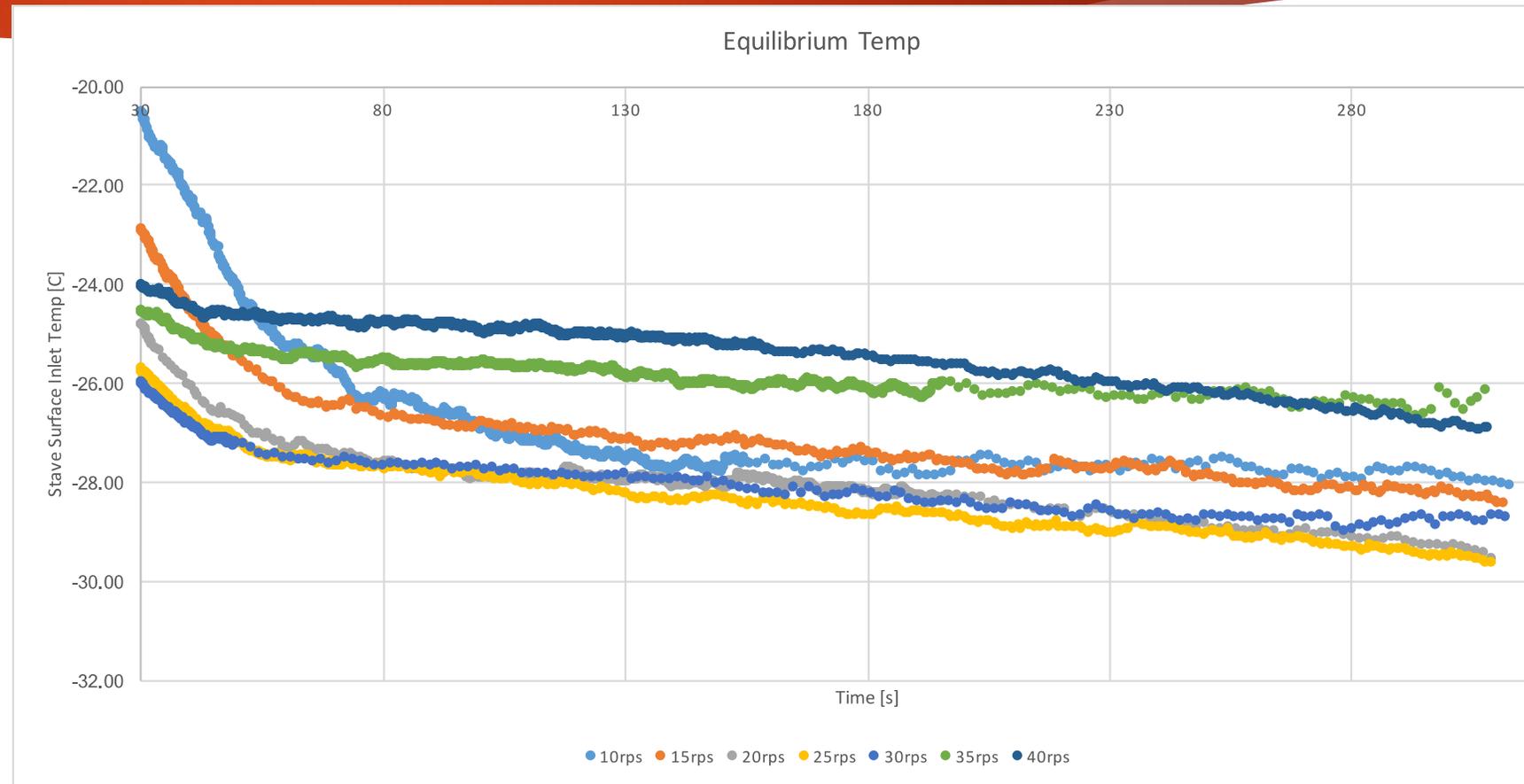
Flow Experiment with N2 in at 5psi

- ▶ Problem with camera measurement in first run?
- ▶ Best curve is the 30rps setting, though 25 is not bad too
- ▶ With greater rps, the steeper the initial drop
- ▶ Above 30 rps the final temperature begins going up



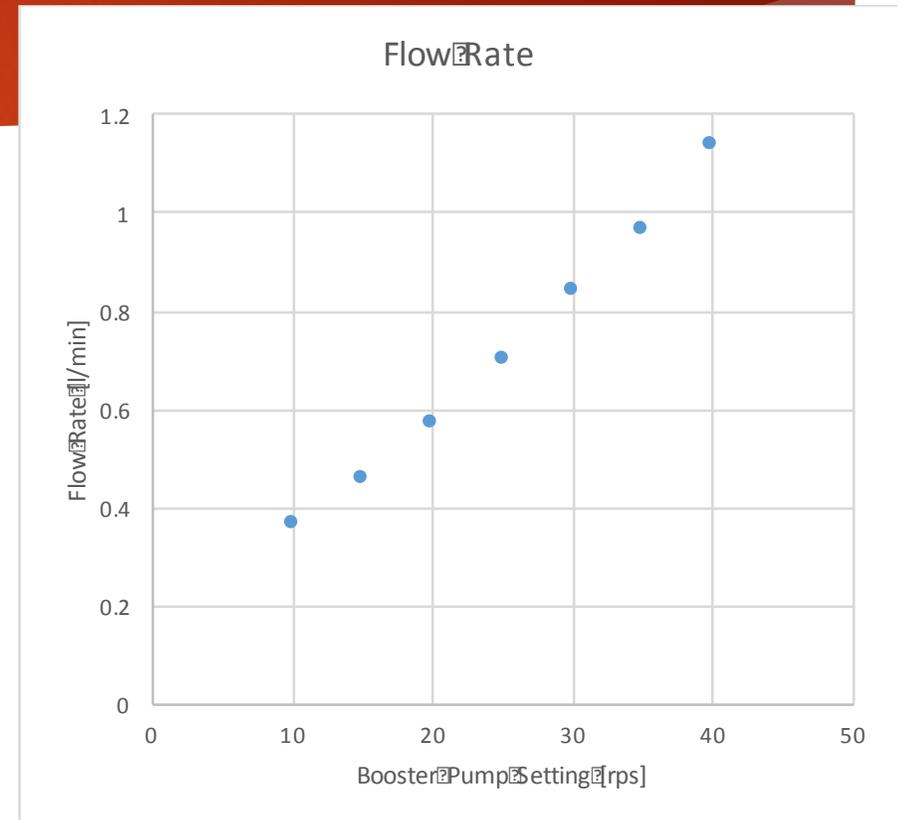
Flow Experiment with N2 in at 5 psi

- ▶ During the 5 minute period, the slopes level off into different curves
- ▶ 20 and 25 rps, both seem to have the best cooling ability
- ▶ All are quite shaky curves. This is due to the airflow across the stave core



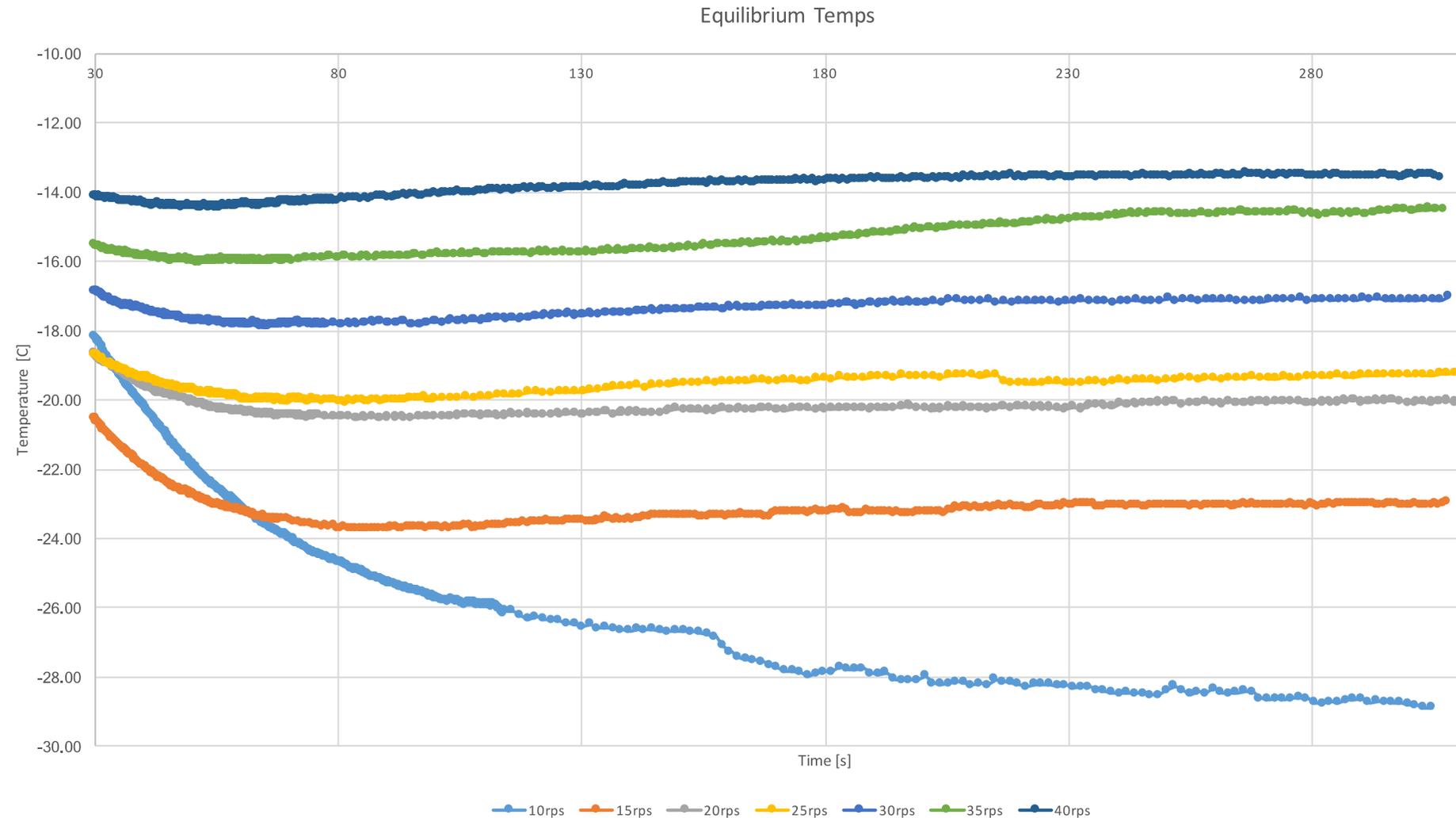
Conclusions Flow Experiment with N₂ in at 5 psi

- ▶ Best measurements were around 20-30 rps
 - ▶ with a flow rate between 0.6-0.8 l/min
 - ▶ with a final temperature around -29C



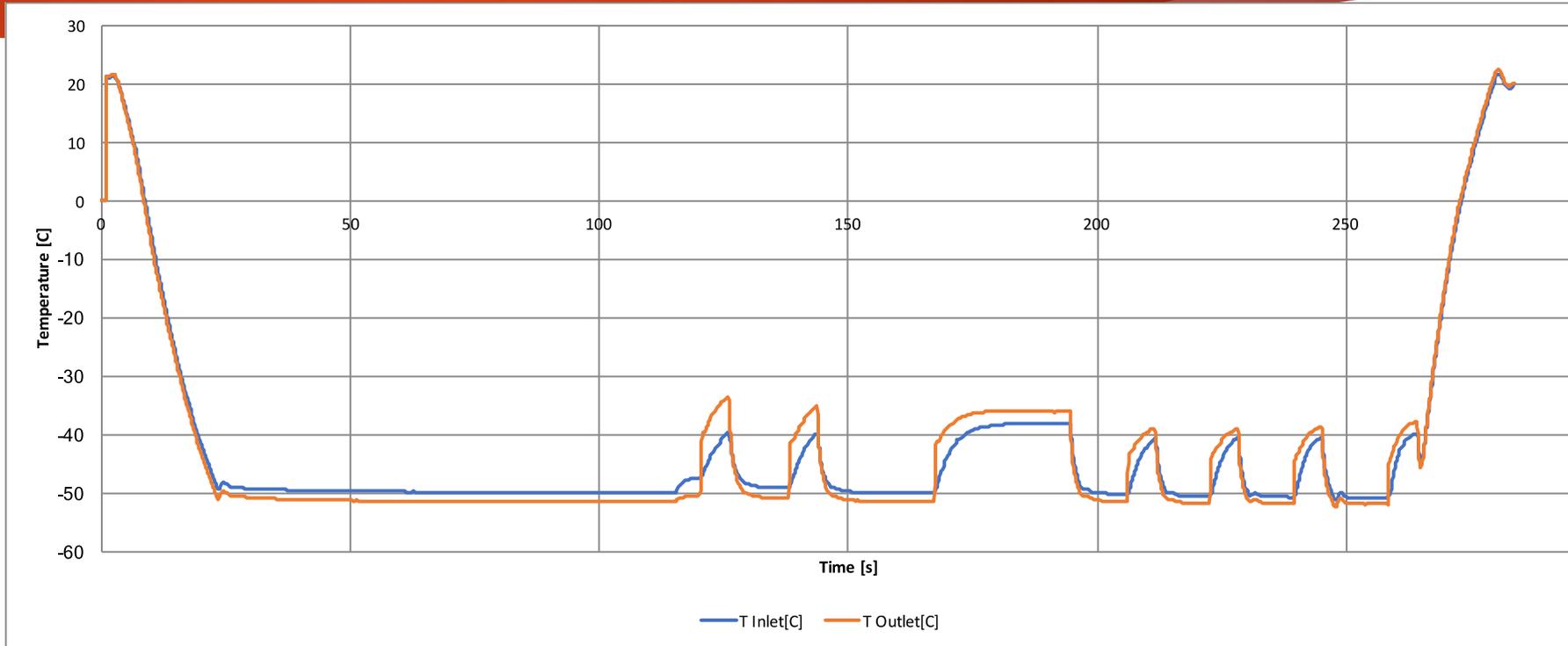
Flow Experiment with no N2

- ▶ These curves are smoother with a minimum sometime after the large drop and then a slight trend upwards
- ▶ The lowest flow rate cools the best?



Conclusions Flow Experiment with no N₂

- ▶ No "best" measurement here. It seems that we have a trade off between minimum temperature and cooling speed
- ▶ Other things noticed
 - ▶ T_{in} and T_{out} were not reading correctly
 - ▶ T_{out} was consistently colder than the inlet



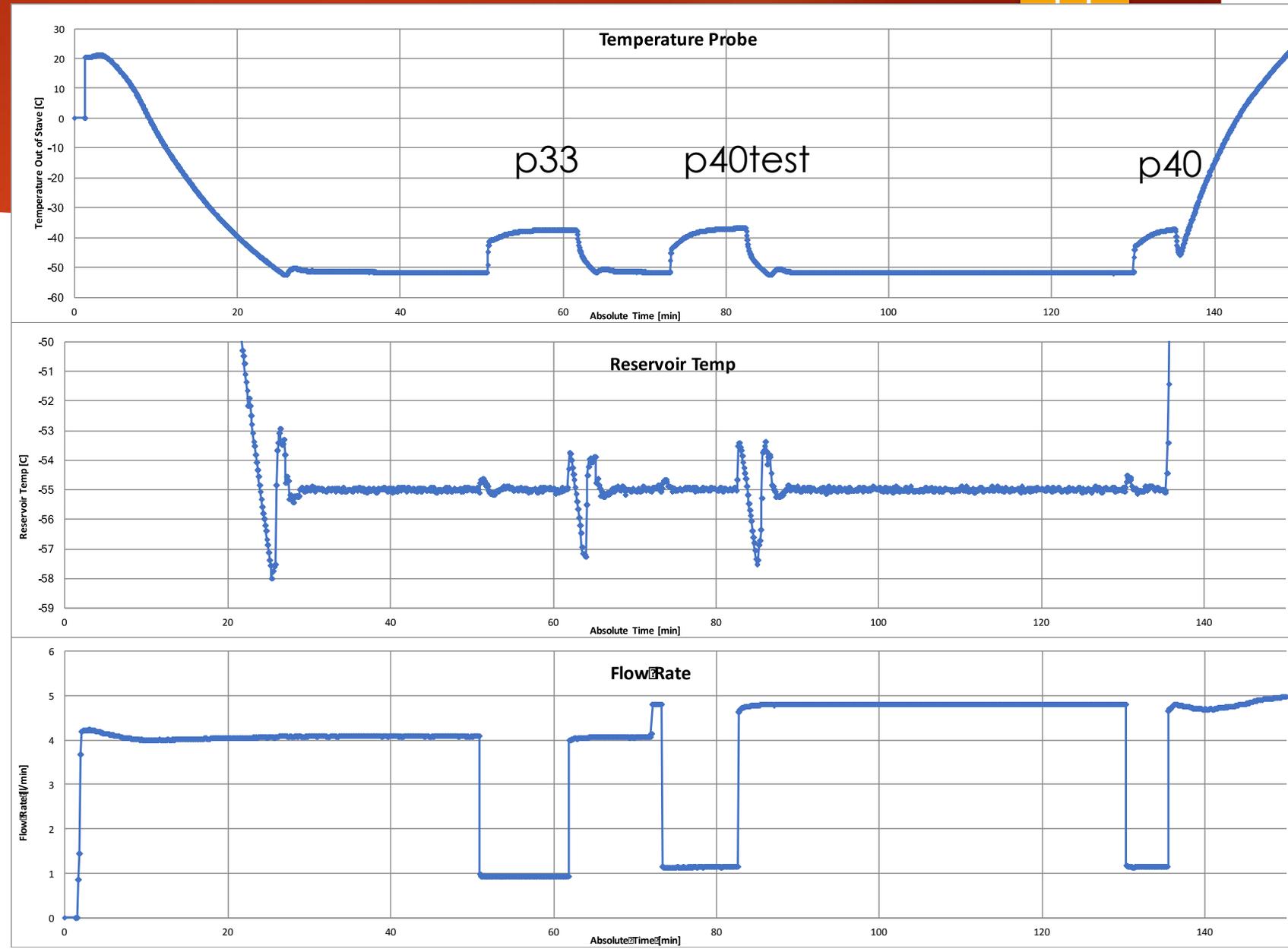
Conclusions

- ▶ Higher flow values improve the speed of cooling but decrease overall cooling of the pipe
- ▶ The best booster pump setting is around 25 rps since a small amount of N2 will need to be on during cycling
 - ▶ Flow rate of around 0.7 l/min
 - ▶ Gives a minimum of -29C after 5 minutes of flow with N2 in at 5psi
 - ▶ Gives a minimum of -19C with no N2 flow
- ▶ Need to calibrate the thermocouples. Seem to have a large amount of variability

Backup Slides

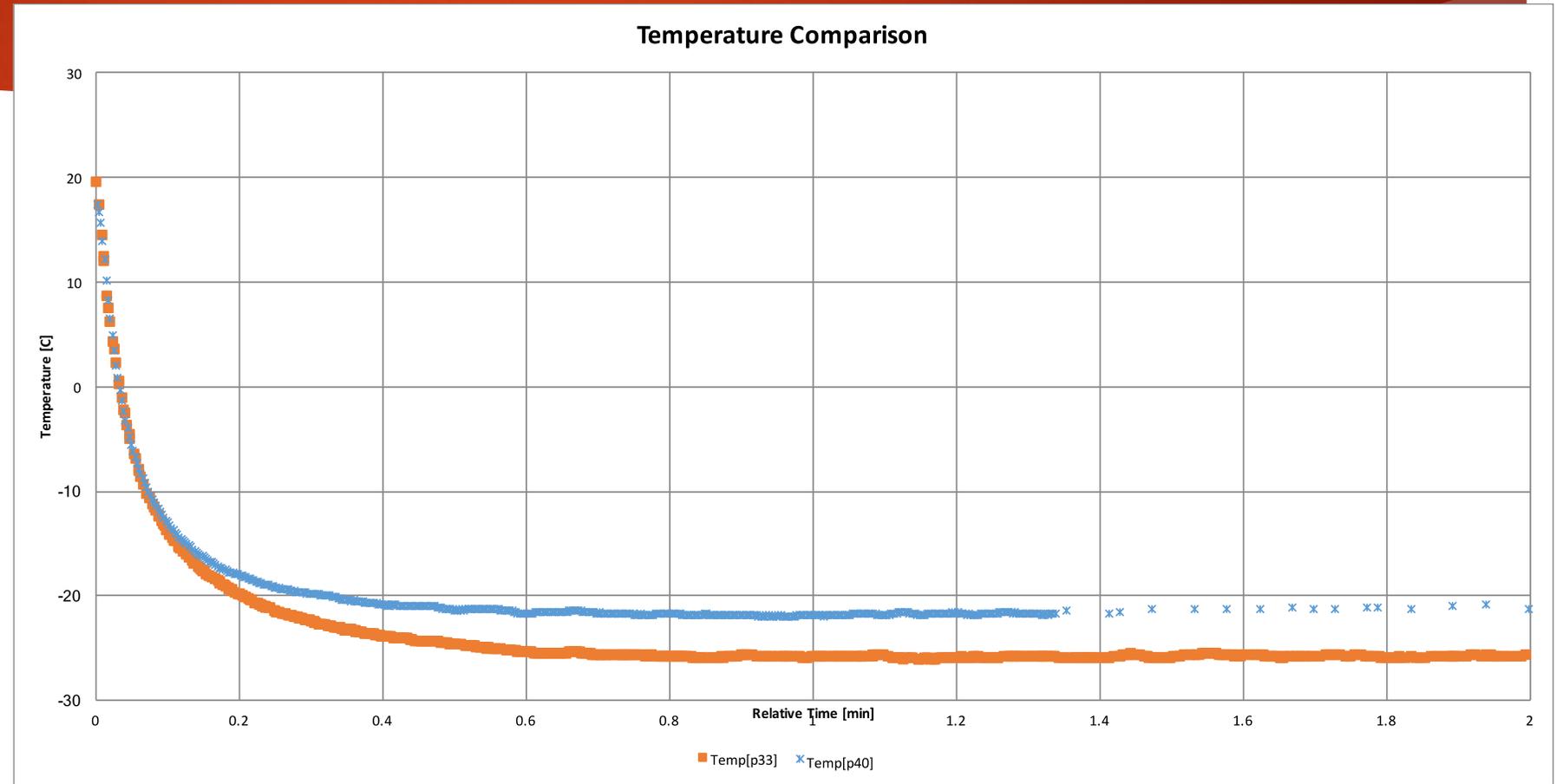
Overall Time

- ▶ Three measurements were taken though only two were recorded fully with the camera.
- ▶ During all three tests the pressure at the stave core was under 250 psi during the run.



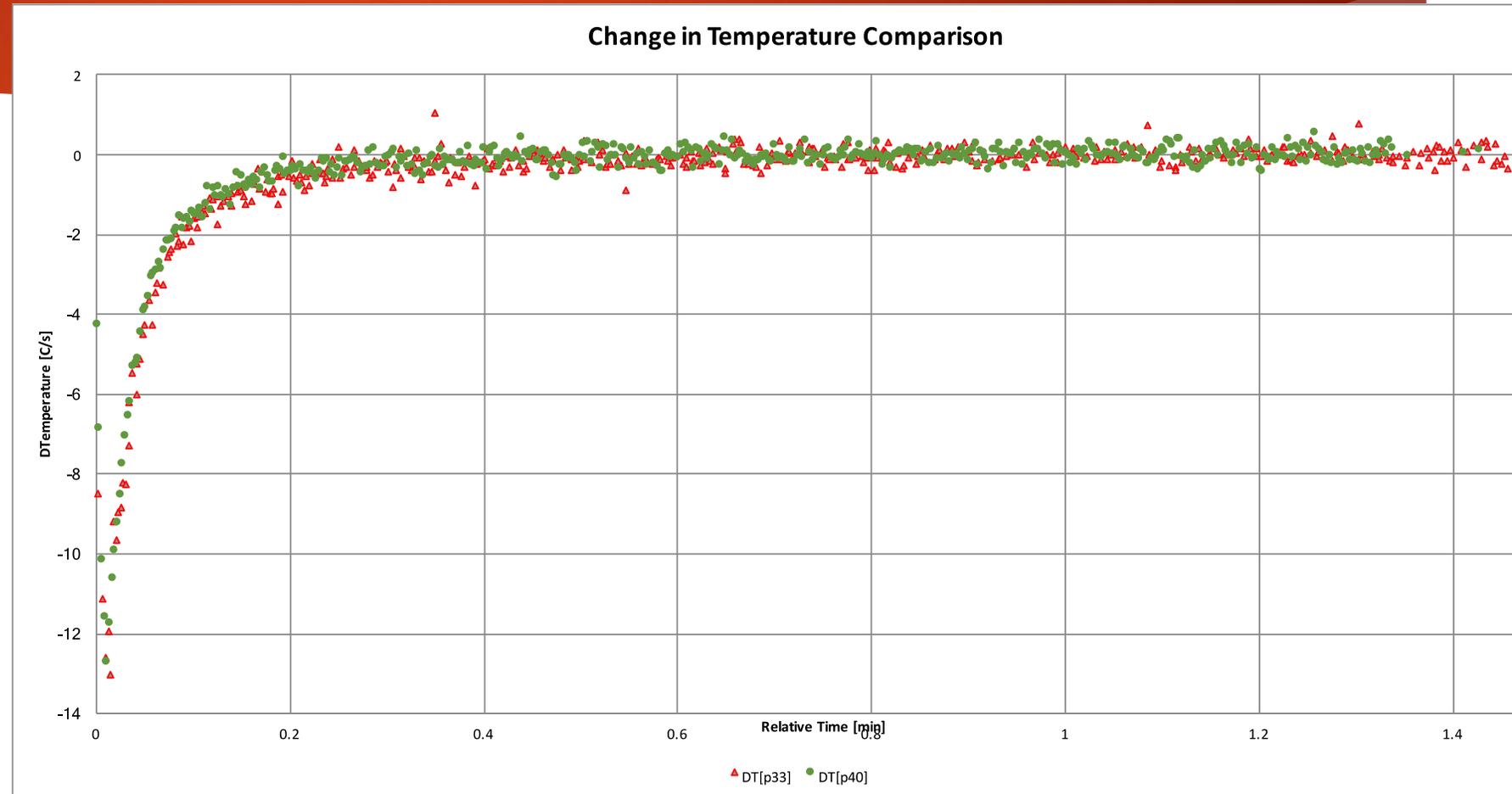
Avg Temp of Inlet

- ▶ This is the average temperature at the surface of the stove along the cooling pipe inlet
- ▶ Higher flow rate gives a higher equilibrium temperature and no major change in cooling rate



Slope of Avg Temp

- ▶ Seem to have a maximum change in temperature around 13 C/s
- ▶ Not much difference between the two measurements
- ▶ Both start level off by around 12 sec at their perspective temperatures, though it takes around 36 sec to get to their minimum temperatures.



Conclusion

- ▶ Higher RPS gives us a greater flow rate, but at the same time it increases our minimum temperature
- ▶ No significant change in stave cooling time between 33rps and 40rps
- ▶ For a rough estimate on thermal shock cycling time it will take less than an hour per cycle with the stave core returning to around 18C near the in/outlets with ambient reheating of the stave core